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ANIMAL BIOGRAPHY;

OR,

ANECDOTES

OF THE

LIVES, MANNERS, AND ECONOMY,

OF THE

ANIMAL CREATION,

ARRANGED ACCORDING TO THE SYSTEM OF LINNÆUS.

By THE REV. W. BINGLEY, A. B.
FELLOW OF THE LINNEAN SOCIETY,
AND LATE OF ST. PETER'S COLLEGE, CAMBRIDGE.

IN THREE VOLUMES.

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AMPHIBIOUS ANIMALS,
FISHES, INSECTS,
WORMS.

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AMPHIBIOUS ANIMALS.

THE title of *Amphibia* is given by Linnæus to the Reptile and Serpent tribes; or to such animals as have cold blood, and live occasionally both on land and in water. It is true that this may be considered exceptionable on account of some individuals being confined to only one of those situations: these are, however, so very few as not, with any propriety, to affect their general denomination.

Their abode is usually in retired, watery and shady places, where they are, most probably, stationed to prevent the excessive multiplication of water animals and insects; and themselves, in many instances, to serve as food for fishes and birds.

They are able, from the peculiar structure of their organs, to suspend respiration at pleasure; and thus to support the change of element uninjured. They have also the power of enduring a degree of abstinence so great as infallibly to prove fatal to any other order of animals.

It is generally *asserted* and believed, that the hearts of the Amphibia are furnished with only one ventricle: more accurate physiologists are however of opinion, that we ought rather to say that they have two ventricles with an immediate communication between them.

The lungs consist, for the most part, of a pair of large bladders or membranaceous receptacles, parted into cancelli or small subdivisions, among which are beautifully distributed their few pulmonary blood-vessels.

Many of the animals possess a high degree of reproductive power, and when their feet, tail, &c. are by any accident destroyed, others will grow in their place. Their bodies are sometimes defended by a hard, horny shield or covering; and sometimes by a coriaceous integument. Some species have scales, and others soft pustular warts or protuberances. Their bones are more cartilaginous than those either of quadrupeds or birds. Several of the species are destitute of ribs. Some are furnished with formidable teeth, while others are entirely without: some again are fierce and predacious; and others perfectly inoffensive. None of them chew their food, but all swallow it whole, and digest it very slowly.

Few, except among the Serpent tribe, are of a poisonous nature, and even of these species not more than one sixth possess this dreadful quality. —They are in general extremely tenacious of life, and many will continue to move and exert animal functions, even destitute of their head.

Their colours are often livid and disgusting;

though some are decorated with most splendid skins. Many of them exhale a loathsome odour, owing perhaps to the foulness of their abode, or the substances on which they feed. Their voices are either harsh and unmusical, or else the animals are entirely dumb.

Most of the Amphibia are oviparous: the eggs of some species are covered with a hard calcareous shell; and those of others have a soft tough skin, or covering, resembling parchment: the eggs of several, as the Frog, Toad, &c. are perfectly gelatinous. In those species that are viviparous, the eggs are regularly formed, but hatched internally, and the young are extruded in perfection: this is the case with the Viper and some others.—In cold and temperate climates nearly all the Amphibia pass the winter in a torpid state.

They are divided by Linnæus into two orders: Reptiles and Serpents*.

1. *Reptiles.* These are furnished with feet, and have flat naked ears without auricles. The principal genera are the Tortoises, Lizards, and Frogs.

2. *Serpents.* These have no feet, but move by the assistance of scales, and their general powers of contortion. Their jaws are dilatable, and not articulated. They have neither fins nor ears.

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* Reptilia and Serpentes.

AMPHIBIOUS ANIMALS.

THE TORTOISE TRIBE.

THIS is one of the dullest and most sluggish of all the animated tribes. Those species that live on land subsist on worms and snails; the others, that inhabit the ocean, feed principally on sea-weeds.

Their body is defended by a bony covering, coated by a horny, scaly, or a cartilaginous integument. The upper jaw closes over the lower like the lid of a box.

This integument or shell consists of two plates joined together at the edges: the upper part is convex, and, in general, is made up of thirteen plates in the middle, surrounded by a margin containing twenty-four. These are connected with the back-bone, and may be considered as ribs. At each end of the two united shells is a hole; the one for the head, neck, and fore-feet to pass through, and the other, at the opposite end, for the hind-feet and tail. From these shells the animal is never disengaged, and they defend it sufficiently from every enemy but man.

The head is small, and, in the place of teeth, has hard and bony ridges. The strength of the jaws is said to be so great, that it is impossible to open them when once they have fastened. Even when the head is cut off the muscles retain a surprising degree of rigidity.

The legs are short, but inconceivably strong: one of the larger species has been known to carry five men, all at the same time, on his back, with great apparent ease and unconcern.

However clumsy and awkward these animals may appear in their manners, they are, for the most part, extremely gentle and peaceable; and few, except the Loggerhead and Fierce Turtles, make any resistance when taken. No animals whatever are more tenacious of life: even if their head be cut off and their chest is opened they will continue to live for several days.—They pass the cold season in a state of torpidity.

The Marine Tortoises or *Turtles* are distinguished from the others by their large and long fin-shaped feet, in which are inclosed the bones of the toes; the first and second only of each foot having visible or projecting claws. The shield, as in the others, consists of a strong bony covering, in which are embedded the ribs: in one or two species this is much thicker and more strong than the shields of Land Tortoises.

Of the Tortoises, there are in the whole about *thirty-six* species: four marine, about eighteen inhabiting the fresh waters, and the rest residing on land.

THE COMMON TORTOISE *.

The Common Tortoise is found in most of the countries near the Mediterranean sea, in Corsica, Sardinia, and some of the islands of the Archipelago, as well as in many parts of the North of Africa.

The length of its shell is seldom more than eight or nine inches, nor does its weight often exceed three pounds. The shell, which, as in most of the other species, is composed of thirteen middle pieces and about twenty-five marginal ones, is of an oval form, extremely convex, and broader towards the hind part than before. The middle part is blackish brown varied with yellow. The under part or belly of the shell is of a pale yellow, with a broad dark line down each side, leaving the middle part plain. The head is not large, nor does the opening of the mouth extend beyond the eyes: the upper part is covered with somewhat irregular scales. The legs are short, and feet moderately broad and covered with strong ovate scales. The tail is somewhat shorter than the legs: it is also covered with scales, but terminates in a horny tip.

This species resides principally in burrows that it forms in the ground, where it sleeps the greatest part of its time, appearing abroad only a few hours in the middle of the day. In the autumn it hides itself for the winter, remaining torpid for four or five months,

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* Synonyms.—Testudo Græca. *Linn.*—Common Land Tortoise. Greek Tortoise.——*Shaw's Gen. Zool. vol. 3. tab. 1.*

and not again making its appearance till the spring. About the beginning of June, the female scratches a hole in some warm situation, in which she deposits her four or five eggs. These are hatched in September, at which time the young are not larger than a walnut.

These Tortoises have often been brought into England. The Rev. Mr. White of Selborne attended accurately to the manners of one that was in possession of a lady of his acquaintance upwards of thirty years. It regularly retired under ground about the middle of November, from whence it did not emerge till the middle of April. Its appetite was always most voracious in the height of summer, eating very little either in spring or autumn. Milky plants, such as lettuces, dandelions and sowthistles, were its principal food. In scraping the ground to form its winter retreat it used its fore-feet, and threw up the earth with its hinder ones over its back; but the motion of its legs was so slow as scarcely to exceed the hour hand of a clock. It worked with the utmost assiduity, both night and day, in scooping out the earth, and forcing its great body into the cavity; notwithstanding which the operation occupied more than a fortnight before it was completed. It was always extremely alarmed when surprised by a sudden shower of rain during its peregrinations for food. Though its shell would have secured it from injury even if run over by the wheel of a loaded cart, yet it discovered as much solicitude about rain as a lady dressed in her most elegant attire, shuffling away on the first sprinklings, and always, if possible, running its head up in a corner.—When the Tortoise is attended to, it becomes an excellent barometer: when it walks elate, and, as it were, on tiptoe, feeding with great earnestness, in a morning, it will, almost invariably, be found to rain before night.—Mr. White was much taken with the sagacity of the above animal in distinguishing those from whom it was accustomed to receive attention: whenever the good old lady came in sight, who had waited on it for more than thirty years, it always hobbled with awkward alacrity towards its benefactress, whilst to strangers it was entirely inattentive. Thus did the most abject of torpid creatures distinguish the hand that fed it, and exhibit marks of gratitude not always to be found in superior orders of animal being. It was a diurnal animal, never stirring out after dark, and very frequently appearing abroad even a few hours only in the middle of the day. It always retired to rest for every shower, and in wet days never came at all from its retreat. Although he loved warm weather, yet he carefully avoided the hot sun, since his thick shell, when once heated, must have become extremely painful and probably dangerous to him. He therefore spent the more sultry hours under the umbrella of a large cabbage leaf, or amidst the waving forests of an asparagus bed. But, as he endeavoured to avoid the heat in the summer, he improved the faint autumnal beams by getting within the reflection of a fruit-tree wall; and though he had certainly never read that planes inclining to the horizon receive a greater share of warmth, he frequently inclined his shell, by tilting it against the wall, to collect and admit every feeble ray*.

Very ample evidence has been produced of this animal's living to a most extraordinary great age, frequently exceeding even the period of a century. One that was introduced into the garden at Lambeth, in the time of archbishop Laud, was living in the year 1753, a hundred and twenty years afterwards; and when at last it perished, it seems to have been more from the accidental neglect of the gardener, than from the mere effect of age.

The horrid experiments of Rhedi to prove the extreme vital tenacity of the Tortoise are a disgrace to the philosophic page. In one instance he made a large opening in the skull, and drew out all the brain, washing the cavity, so as not to leave the smallest part remaining, and then, with the hole open, set the animal at liberty. It marched off, as he says, without seeming to have received the slightest injury, save from the closing of its eyes, which it never afterwards opened. In a short time the hole was observed to close, and in about three days a complete skin covered the wound: in this manner the animal lived, without the brain, for six months, walking about, and still moving its limbs as it did previous to the operation.

The males of this species are said to fight very often: this is done by butting at each other, and with such force as to be heard at a considerable distance†.

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* White's Selborne.

† Shaw's Gen. Zool. iii. p. 9.

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It is generally *asserted* and believed, that the

THE SOFT-SHELLED TORTOISE *.

This species is found in great quantities in the fresh-water rivers and lakes of East Florida, and the southern parts of Carolina, far remote from the sea. Its colour is deep olive brown above, and white beneath. The middle part of the shell is hard, strong and bony; but all round the sides, and particularly towards the tail, it is cartilaginous, soft and pliable, resembling thick tanned sole-leather, strong enough to defend it from any external injury, yet yielding easily to a force impressed in any direction. The head and snout, the latter of which is long and in shape not much unlike that of the mole, distinguish it from every other species. The neck is thick, and capable both of being extended to a great length, and of being drawn in under the plate of the shell. The upper parts of the body are studded with knobs. The fore-feet are thick and strong, and, as well as the others, have three claws each.

Some individuals weigh so much as seventy pounds. They frequent muddy rivers and lakes, hiding themselves among the roots and leaves of the water-plants, from whence they spring on their prey. By suddenly stretching out their neck, which they do with wonderful celerity, they are frequently able to seize young birds and other small animals. When attacked or disturbed they exhibit a most

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* Synonyms.—Testudo ferox. *Linn.*—Soft-shelled Tortoise, Fresh-water Tortoise. *Penn.*—Great soft-billed Turtle. *Bartram.* —Fierce Tortoise.——*Shaw's Gen. Zool. vol.* 3. *tab.* 17.

ferocious disposition, raising themselves on their legs, and leaping forward with the utmost fury to lay hold of their enemy; and, when they have once fixed, it is extremely difficult to make their jaws quit the hold they have got. They are, in addition to this, both very strong and active.

They are said to be excellent food, and preferable in delicacy of flavour to the Green Turtles[*].

THE SNAKE TORTOISE[†].

This animal inhabits the stagnant waters of North America, and when full-grown weighs from fifteen to twenty pounds.

The shield is oval, and somewhat depressed: the middle pieces, which are thirteen in number, each rise into a kind of obtuse point. The margin, near the tail, is deeply serrated. The head is large, flat, triangular, and covered with a warty ſkin. The mouth is wide, and the mandibles are sharp. The neck, though it appears short and thick when the animal is at rest, is capable of being stretched out to a third of the length of the shell. The toes are connected by a web, and the claws are long and stout. The tail is straight, and about two-thirds of the length of the shell. In its general colour this species is of a dull chesnut brown, paler beneath than above.

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[*] Paper of Dr. Garden. Phil. Tran. vol. lxi. p. 266.

[†] SYNONYMS.—Testudo serpentina. *Linn.*—Serrated Tortoise. *Penn.*—Snapping Tortoise, in some parts of America. Snake Tortoiſe. *Shaw.*——*Shaw's Gen. Zool. vol. 3. tab. 19.*

It preys on fish, young water-fowl, &c. which it seizes with great force, at the same time stretching out its neck and hissing. Whatever it once seizes in its mouth it retains with great force, and will suffer itself to be raised up rather than quit its hold. It lies concealed in muddy waters in such a manner as to leave out only a part of its back, appearing like a stone, or rough piece of wood; by which means it is enabled the more eaſily to lay hold of such animals as unguardedly venture near it.

The two following Species are Marine Tortoises, or, as they are usually denominated, Turtles.

THE GREEN TURTLE*.

The Green or Esculent Turtle inhabits various parts of the southern seas; and is brought to this country in great quantities from the West India islands to supply the tables of our epicures. Its length is often five feet or upwards, and it frequently weighs so much as five or six hundred pounds. The shell is broader before than behind, where it is somewhat pointed; and it consists of thirteen brownish divisions, surrounded by twenty-five marginal ones.

It feeds on shell-fish and sea plants, and principally on the *Zostera marina*, which is often called from this circumstance turtle-grass. Its strength is so great as to allow it to move along with as many men as can stand on its back. It sleeps upon its back on the surface of the water. The legs are so far fin-shaped as to be of little other use than to swim with.

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* SYNONYMS.—Testudo Mydas. *Linn.*—Common Green Turtle. Common Turtle. Esculent Turtle. Green Turtle. *Shaw.* ——*Shaw's Gen. Zool. vol.* 3. *tab.* 22.

The inhabitants of the Bahama islands are peculiarly dexterous in catching the Turtles. In the month of April they go in their boats to the coasts of Cuba, and some of the neighbouring islands, where in the evenings and moonlight nights they watch the going and returning of the animals to and from the shore, where they lay their eggs. They turn them on their backs on the land, and then leave them to perform the same operation on others, as many as they can meet; for, when once turned, they are unable again to get on their feet. Many are taken in the sea, at some distance from the shore: these are struck with a kind of spear whose shaft is about four yards in length. For this work two men usually set out in a small light boat or canoe, one to paddle it gently along and steer, and the other to stand at the head with his weapon. Sometimes the Turtles are discovered swimming with their head and back out of water, but most commonly lying at the bottom where it is a fathom or more deep. If the animal sees that he is discovered, he immediately attempts to escape: the men pursue and endeavour to keep him in sight; and, in the chase, generally so far tire him, that in the course of half an hour he sinks to the bottom, which affords an opportunity to strike him with the spear through the shell. ~~The head of the spear~~, which now slips off and is left in his body, is fastened with a string to the pole; and by means of this apparatus they are enabled to pursue him, if he should not be sufficiently spent without: if, however, that is the case, he tamely submits to be taken into the boat, or hauled ashore.—There are men who by diving to the bottom will get on their backs; and then by pressing them down behind, and raising their fore part, bring them by force to the surface of the water, where some person is in waiting to slip a noose round their neck.

They very seldom go ashore except for the purpose of depositing their eggs in the sand. This is done in April. They dig a hole, at high-water mark, about two feet deep, and drop into it above a hundred eggs; and at this time they are so intent on the operation, that they do not notice any one that approaches them, and they will even drop the eggs into a hat if held under them. If, however, they are disturbed before the commencement of their business, they always forsake the place. They lay their eggs at three and sometimes four different times, fourteen days asunder, so that the young are hatched and come forth also at different times. After having deposited the eggs they scratch the hole up with sand, and leave them to be hatched by the heat of the sun, which is generally done in about three weeks. The eggs are about the size of a tennis-ball, round, white, and covered with a parchment-like skin*.

Sir Hans Sloane has informed us that the inhabitants of Port Royal in Jamaica had formerly no fewer than forty vessels employed in taking these animals, their markets being supplied with Turtle, as ours are with butchers meat.

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* Catesby, ii. 38.

The introduction of the Turtle, as an article of luxury, into England, appears to have taken place within the last seventy years.

THE LOGGERHEAD TURTLE[*].

This is one of the largest species, and in its general appearance has a great resemblance to the last: the head however is larger, the shell broader, and the number of segments of the disk is fifteen, of which the middle range is gibbous or protuberant towards their tips. The fore-feet are large and strong, and the hind ones broad and much shorter than these.—They inhabit the seas about the West India islands, and they are found in the Mediterranean, but particularly about the coasts of Italy and Sicily.

They are very strong and fierce, defending themselves with great vigour with their legs, and being able to divide very strong substances with their mouth. Aldrovandus assures us that, on offering a thick walking-stick to the gripe of one that he saw publicly exhibited at Bologna, the animal bit it in two in an instant[†].—Their principal food is shell-fish, which their strong beak enables them easily to break from the rocks.

They range very far over the ocean. One of them was seen in latitude 30° north, sleeping on the surface of the water, apparently about midway between the Azores and the Bahama islands, and these were the nearest possible land. This circumstance was the more remarkable as it happened in the month of April, just at their breeding time*.

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[*] Testudo caretta. *Linn.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 23, 24, 25.

[†] Shaw's Gen. Zool. iii. 87.

Like the last species, they lay their eggs in the sand. Their flesh is coarse and rank; but their bodies afford a considerable quantity of oil, which may be used for various purposes. The plates of the shell are not sufficiently thick to be of great use.

The substance that we call *Tortoise-shell* is the production of the Imbricated Turtle†, a species, considerably allied to the present, that is found in the Asiatic and American seas, and sometimes in the Mediterranean. The plates of this species are far more strong, thick and clear, than in any other, and these constitute the sole value of the animal. They are semi-transparent, beautifully variegated with different colours, and, when properly prepared and polished, are used for a variety of ornamental purposes. They are first softened by steeping in boiling water, after which they may be moulded into almost any form ‡.

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* Catesby, ii. 40.

† Testudo imbricata of Linnæus.

‡ Shaw's Gen. Zool. iii. 89.

THE FROG TRIBE.

THE animals that compose this tribe feed on insects and worms, residing principally on the ground, or partly in water, in dark and unfrequented places, from whence they crawl forth only in the night. Many of them have an aspect very disgusting and unpleasant. Some, however, are furnished with slender limbs, and have their toes terminated by flat circularly expanded tips, which enable them to adhere at pleasure to the surfaces of even the smoothest bodies: these reside generally in the trees, where they adhere to the lower sides of the leaves or branches. —None of them drink, but all the species absorb moisture through the skin.

They are all oviparous, and the eggs are perfectly gelatinous. From the egg proceeds a Tadpole without feet, but furnished with a tail to aid its motions in the water: this drops off as the legs become protruded. In this state they have also a sort of gills or subsidiary lungs; and several of them a small tube on the lower lip, by means of which they can fix themselves to bodies, to eat, or perform other functions. They all arrive at maturity about their fourth year, and very few outlive the age of ten or twelve.

The full-grown animals have four feet, and their body is not covered with either plates or scales, but is entirely naked. They are destitute of tails, and their hind-legs are longer than the others.

The number of species hitherto described is about *fifty*. These are divided into three sections; namely,

Frogs, which have smooth bodies, longish legs, and discharge their eggs in a mass.

Hylæ, that have their hind-legs very long, and the toes unconnected; and

Toads, which have their bodies puffed up and covered with warts. These have also short legs, and do not leap; and discharge their eggs in a very long necklace-like string.

THE COMMON FROG[*].

The Common Frog is found in great quantities in moist situations throughout Europe. Its colour is olive brown variegated above with irregular blackish spots. Beneath each eye is a patch or mark that reaches to the setting-on of the fore-legs.

Its appearance is lively, and its form on the whole by no means inelegant. The limbs are well calculated for aiding the peculiar motions of the animal, and its webbed hind-feet assist its progress in the water; to which it occasionally retires during the heats of summer, and again in the frosts of winter. During the latter period, and till the return of warmer weather, it lies in a state of torpidity, either deeply plunged in the soft mud at the bottom of stagnant waters, or in the hollows beneath their banks.

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[*] Rana temporaria. *Linn.*——*Shaw's Gen. Zool..vol.* 3. *tab.* 39.

Its spawn, which is cast generally in the month of March, consists of a clustered mass of gelatinous transparent and spherical eggs, in the middle of each of which is contained the embryo or tadpole, in the form of a black globule. The spawn lies a month or five weeks, according to the heat of the weather, before the larvæ or tadpoles are hatched.

The tadpole, as in several other species, is furnished with a kind of small tubular sucker beneath the lower jaw, by means of which it hangs at pleasure to the under surface of aquatic plants. The interior organs, when closely examined, are found to differ in many respects from those of the future Frog. The intestines, in particular, are coiled into a flat spiral form, somewhat resembling a cable in miniature. When the animal is about six weeks old the hind-legs appear, and in about a fortnight these are succeeded by the fore-legs: in this state it seems to have alliance both to the Frog and Lizard. Not long afterwards the form is completed, and it, for the first time, ventures upon land. Frogs are at this period often seen wandering about the brinks of the water, in such multitudes as to astonish mankind, and induce a belief among the vulgar of their having descended in showers from the clouds.

They now surrender their vegetable food for the smaller species of snails, worms, and insects; and the structure of their tongue is admirably adapted to seizing and securing this prey: the root is attached to the fore-part of the mouth, so that when unemployed it lies with the tip towards the throat. The animal is by this singular contrivance enabled to bend it to a considerable distance out of its mouth. When it is about to seize on any object, it darts it out with great agility, and the prey is secured on its broad and jagged glutinous extremity. This it swallows with so instantaneous a motion that the eye can scarcely follow it*.

Nothing canappear more awkward and ludicrous than a frog engaged with a large worm or a small snake; for nature seems to have put a restraint upon the voracity of these animals, by forming them very inaptly for seizing and holding their larger prey. Dr. Townson had a large Frog that one day swallowed in his presence a Blind-worm † near a span long, which in its struggles frequently got half its body out again; when completely swallowed, its contortions were very visible in the flaccid sides of its victor ‡.

With respect to the popular superstition that Frogs frequently descend from the clouds, Mr. Ray informs us, that as he was riding one afternoon in Berkshire, he was much surprised at seeing an immense multitude of Frogs crossing the road. On further examination he found two or three acres of ground nearly covered with them; they were all proceeding in the same direction, towards some woods and ditches that were before them. He however traced them back to the side of a very large pond, which in spawning-time he was informed always abounded so much with Frogs, that their croaking was frequently heard to a great distance; and he therefore naturally concluded that instead of being precipitated from the clouds, they had been bred there, and had been invited by a refreshing shower, which had just before fallen, to go out either in pursuit of food or of a more convenient habitation*.

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* Shaw's Gen. Zool. iii. 97. † Anguis fragilis of Linnæus.
‡ Townson's Tracts.

Frogs are numerous in the parts of America about Hudson's Bay as far north as latitude 61°. They frequent there the margins of lakes, ponds, rivers, and swamps; and as the winter approaches, they burrow under the moss, at a considerable distance from the water, where they remain in a frozen state till spring. Mr. Hearne says he has frequently seen them dug up with the moss frozen as hard as ice. In this state their legs are as easily broken off as the stem of a tobacco pipe, without giving them the least sensation: but by wrapping them up in warm skins, and exposing them to a slow fire, they soon come to life, and the mutilated animals gain their usual activity: if, however, they are permitted to freeze again, they are past all recovery †.

The mode of respiration in these animals, in common with many of the other reptiles, is exceedingly curious. The organs adapted to this use are not placed in the belly, nor in the lungs themselves, but in the mouth. Behind the root of the tongue is the slit-like opening of the trachea: and at the front of the upper part of the head are two nostrils, through which the animal always draws the air, never opening its mouth for this purpose. Indeed the jaws during this action are kept closely locked into each other by grooves; for if the mouth is kept open it cannot respire at all, and the animal will presently be seen struggling for breath. When we observe it carefully, we perceive a frequent dilatation and contraction in the skinny bag-like part of the mouth which covers the under jaw. From this it would appear at first sight, as if the creature lived all the while on one mouthful of air, which it seems to be playing backwards and forwards betwixt its mouth and lungs. But for each movement in the jaw a corresponding twirling movement may be observed in the nostrils. The mouth seems therefore to form a sort of bellows, of which the nostrils are the air-holes, and the muscles of the jaws by their contraction and relaxation make the draught. The nostrils are so situated that the least motion on them enables them to perform the office of a valve. By the twirl of the nostril the air is let into the mouth, when a dilatation of the bag takes place: it is then emptied from the mouth, through the slit behind the tongue, into the lungs, when there is a slight motion in the sides of the animal, and the muscles of the abdomen again expel it; and soon afterwards a second twirl in the nostrils takes place, and the like motions follow. Thus it appears that the lungs are filled by the working of the jaws, or, in other words, that Frogs swallow air much in the same manner that we swallow food.

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* Ray's Wonders of the Creation, 165.

† Hearne, 397.

Frogs cast their skins at certain periods.—They arrive at full age in about five years, and are supposed to live to twelve or fifteen.—Their voice is hoarse and unpleasant.—They are so tenacious of life as to survive even the loss of their head for several hours.

This species is not so much in request for food as the following, not being so white, nor altogether so palatable. The hind-legs, however, are eaten, and the fore-legs and livers often form an ingredient in the continental soups.

THE EDIBLE FROG*.

The Edible Frog is considerably larger than the common species, and, though somewhat rare in England, is found in plenty in Italy, France, and Germany.

Its colour is an olive green, distinctly marked with black patches on the back, and on its limbs with transverse bars of the same. From the tip of the nose, three distinct stripes of pale yellow extend to the extremity of the body, the middle one slightly depressed, and the lateral ones considerably elevated. The under parts are of a pale whitish colour tinged with green, and marked with irregular brown spots.

The spawn of the present species is not often deposited before the month of June. During this season the male is said to croak so loud as to be heard to a great distance. In some particular places where these animals are numerous, their croaking is very oppressive to persons unaccustomed to it.

The globules of spawn are smaller than those of the Common Frog, and the young are considerably longer in attaining their complete state, this seldom taking place till November. They arrive at their full growth in about four years, and live to the age of sixteen or seventeen.—They are excessively voracious, frequently seizing young birds, and even mice, which like the rest of their prey of snails, worms, &c. they swallow whole*.

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* SYNONYMS.—Rana esculenta. *Linn.*—Esculent Frog, Green Frog. *Shaw.*—Edible Frog. *Penn.* ——*Shaw's Gen. Zool. vol.* 3. *tab.* 31.

These poor creatures are brought from the country, thirty or forty thousand at a time, to Vienna, and sold to the great dealers, who have conservatories for them, which are large holes, four or five feet deep, dug in the ground, the mouth covered with a board, and in severe weather with straw. In these conservatories, even during a hard frost, the frogs never become quite torpid. When taken out and placed on their backs, they are always sensible of the change, and have strength enough to turn themselves. They get together in heaps, one upon another, instinctively, and thereby prevent the evaporation of their humidity; for no water is ever put to them. In Vienna, in the year 1793, there were only three great dealers; by whom most of those persons were supplied who brought them to the market ready for the cook†.

From their spawning-time being very late, it is supposed that those animals that are brought to market before the month of June for the Edible Frog, are either Common Frogs, or sometimes that they are even Toads.

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* Shaw's Gen. Zool. iii. 103.

† Townson's Travels, 14.

THE BULL FROG *.

This is an animal that frequently measures from the nose to the hind-feet a foot and a half, or upwards. The colour of its body is a dusky olive or brown, marked with numerous dark spots, lighter beneath than above. The external membranes of the ears are large, round, and of a brownish red, surrounded by a yellowish margin.

The interior parts of America are the principal residence of this species, where, at the springs or small rills, they are said to sit in pairs. In Virginia they are in such abundance, that there is scarcely a single spring that has not a pair of them. When suddenly surprised, by a long leap or two they enter the hole, at the bottom of which they lie perfectly secure. The inhabitants fancy that they purify the water, and respect them as genii of the fountains †. —Kalm informs us that they frequent only ponds and marshes.

Their croaking is said somewhat to resemble the hoarse lowing of a bull; and when, in a calm night, many of them are making a noise together, they may be heard to the distance of a mile and a half. The night is the time when they croak, and they are said to do it at intervals. In

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* SYNONYMS.—Rana Catesbeiana. *Shaw.*—Rana ocellata. *Linn.*??—Bull Frog. *Catesby.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 33.

Dr. Shaw is of opinion that Linnæus has described the Argus Frog of General Zoology under the name of Rana ocellata.

† Catesby, ii. 72.

this act they are either hidden among the grass or rushes, or they are in the water, with their heads above the surface *.

When alarmed they leap to a most surprising distance at each exertion. A full-grown Bull Frog will sometimes leap three yards. The following story respecting one of them is well authenticated. The American Indians are known to be excellent runners, being almost able to equal the best horse in its swiftest course. In order, therefore, to try how well the Bull Frogs could leap, some Swedes laid a wager with a young Indian, that he could not overtake one of them, provided it had two leaps beforehand. They carried a Bull Frog which they had caught in a pond, into a field, and burnt its tail. The fire, and the Indian who endeavoured to get up to the frog, had together such an effect upon the animal, that it made its long leaps across the field as fast as it could. The Indian pursued it with all his might. The noise he made in running frightened the poor frog; probably it was afraid of being tortured with fire again, and therefore it redoubled its leaps, and by that means reached the pond, which was fixed on as their goal, before the Indian could overtake it †.

The women are no friends to these frogs, because they kill and eat young ducks and goslings; and sometimes they carry off chickens that venture too near the ponds.—During winter they remain in a torpid state under the mud: and in spring they commence their bellowings.

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* La Hontan. † Kalm.

They are edible, and have frequently as much meat on them as a young fowl.—A few years ago ſome of them were brought alive into this country.

THE TREE FROG*.

The Tree Frog is a native of America, of France, Germany, Italy, and many other European regions, but is not found in Britain.—It is ſmall, and of a ſlender and very elegant shape. Its upper parts are green, and the abdomen is whitish, marked by numerous granules. The under surfaces of the limbs are reddish; and on each side of the body is a longitudinal blackish or violet-coloured streak. The body is smooth above, and the hind-legs are very long and slender. At the end of each toe is a round, fleshy, concave apparatus, not unlike the mouth of a leech, by means of which the animal is enabled to adhere even to the most polished surfaces†.

During the summer months it resides principally on the upper branches of the trees, where it wanders among the foliage in quest of insects. These it catches with great dexterity, stealing softly towards them as a cat does towards a mouse, till at a proper distance, when it makes a sudden spring upon them, of frequently more than a foot in height.—It often suspends itself by its feet, or abdomen, to the under

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[*] SYNONYMS.—Rana arborea. *Linn.*—Rana bilineata. *Shaw.*—Green Tree Frog. *Catesby.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 38.

[†] Catesby, ii. 71. Shaw's Gen. Zool. iii. 130.

parts of leaves, remaining thus concealed among the foliage.

The skin of the abdomen is covered with ſmall glandular granules of such a nature as to allow the animal to adhere as well by these as by the toes. It will even stick to a glass by pressing its belly against it.

Although during summer it inhabits the woods, yet about the end of autumn it retires to the waters, and lies concealed in a torpid state, in the mud or under the banks, till the spring; when, on the return of warm weather, it emerges, like the rest of the genus, to deposit its spawn in the water. At this period the male inflates its throat in a surprising manner, forming a large sphere beneath its head. It also exerts a very loud and sharp croak, that is heard to a vast distance. The tadpoles become perfected about the beginning of August, and they soon afterwards begin to aſcend the adjacent trees.

During their residence in the trees, these frogs are particularly noisy in the evenings on the approach of rain. They are indeed so excellent as barometers, that, if kept in glasses in a room, and supplied with proper food, they afford sure presage of changes of the weather*.

In order to make some observations on the reſpiration of the Reptile tribe, Dr. Townson had among others some Tree Frogs. He kept them in a window, and appropriated to their use a bowl of water, in which they lived. They soon grew quite tame; and to two that he had for a considerable length of time, and were particular favourites, he gave the names of Damon and Musidora. In the hot weather whenever they descended to the floor they soon became lank and emaciated. In the evening they seldom failed to go into the water, unless the weather was cold and damp; in which case they would sometimes remain out a couple of days. When they were out of the water, if a few drops were thrown upon the board, they always applied their bodies as close to it as they could; and from this absorption through the skin, though they were flaccid before, they soon again appeared plump. A Tree Frog that had not been in the water during the night was weighed, and then immersed: after it had remained about half an hour in the bowl, it came out, and was found to have absorbed nearly half its own weight of water. From other experiments on the Tree Frogs it was discovered that they frequently absorbed nearly their whole weight of water, and that, as was clearly proved, and is very remarkable, by the under surface only of the body. They will even absorb moisture from wetted blotting-paper. Sometimes they eject water with a considerable force from their bodies, to the quantity of a fourth part or more of their own weight*.

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* Shaw's Gen. Zool. iii. 130.

Both Frogs and Toads will frequently suffer their natural food to remain before them untouched, yet on the smallest motion it makes they instantly seize it. A knowledge of this circumstance enabled Dr. Townson to feed his favourite Tree Frog, Musidora, through the winter. Before the flies, which were her usual food, had disappeared in autumn, he collected for her a great quantity as winter provision. When he laid any of them before her, she took no notice of them, but the moment he moved them with his breath she sprung upon and ate them. Once, when flies were scarce, the Doctor cut some flesh of a tortoise into small pieces, and moved them by the same means. She seized them, but the instant afterwards rejected them from her tongue. After he had obtained her confidence, she ate, from his fingers, dead as well as living flies. Frogs will leap at a moving shadow of any small object; and both Frogs and Toads will soon become sufficiently familiar to sit on the hand, and be carried from one side of a room to the other, to catch flies as they settle on the wall.—At Gottingen Dr. Townson made them his guards for keeping these troublesome creatures from his dessert of fruit, and they acquitted themselves fully to his satisfaction. —He has even seen the small Tree Frogs eat humble-bees, but this was never done without some contest: they are in general obliged to reject them, being incommoded by their stings and hairy roughness; but in each attempt the bee is further covered with the viscid matter from the frog's tongue, and when pretty well coated with this it is easily swallowed *.

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* Townson's Tracts, 51.

A Tree Frog was kept by a surgeon in Germany for near eight years. He had it in a glass vessel covered with a net, and during the summer he fed it

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* Townson's Tracts, 113, 114.

with flies, but in winter it probably did not eat at all, as only a few insects, with grass and moistened hay, were put to it. During this season it was very lean and emaciated; but in summer, when its favorite food could be had in plenty, it soon again became fat. In the eighth winter it pined away by degrees, as was supposed, on account of no insects whatever being to be had*.

As captain Stedman was sailing up one of the rivers of Surinam in a canoe, one of the officers who was with him observed, in the top of a mangrove tree, a battle between a Snake and a Tree Frog. When the captain first perceived them, the head and shoulders of the frog were in the jaws of the snake, which was about the size of a large kitchen poker. This creature had its tail twisted round a tough limb of the mangrove; while the frog, which appeared about the size of a man's fist, had laid hold of a twig with his hind-feet. In this position they were contending, the one for life, the other for his dinner, forming one straight line between the two branches; and thus they continued for some time, apparently stationary, and without a struggle. Still it was hoped that the poor frog might extricate himself by his exertions: but the reverse was the case. The jaws of the snake gradually relaxing, and by their elasticity forming an incredible orifice, the body and fore-legs of the frog by little and little disappeared, till finally nothing more was seen than the hinder feet and claws, which were at last disengaged from the twig, and the poor creature was swallowed whole by suction down the throat of his formidable adversary. He passed some inches further down the alimentary canal, and at last stuck, forming a knob or knot at least six times as thick as the snake, whose jaws and throat immediately contracted, and reassumed their former natural shape. The snake being out of reach of musket shot, they could not kill him to make any further examination, but left him, continuing in the same attitude, motionless, and twisted round the branch*.

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* Ephemerides Naturæ curiosorum.

THE COMMON TOAD†.

The Toad is an animal known to every one: and by his livid appearance, and sluggish and disgusting movements, is easily recognized.

The females deposit their spawn early in the spring, in the form of necklace-like chains or strings of beautifully transparent gluten, three or four feet in length, inclosing the ova in a double series throughout. These have the appearance of so many jet-black globules: they are, however, nothing more than the larvæ or tadpoles lying in a globular form. These break from their confinement in about a fortnight, and afterwards undergo changes very similar to the tadpoles of the frog. They become complete about the beginning of autumn, when the young animals are frequently to be seen in immense multitudes.

When it is irritated the Toad emits from various parts of its skin a kind of frothy fluid, that in our climate produces no further unpleasant symptoms than slight inflammation from its weakly acrimonious nature. Dogs, on seizing these animals, appear to be affected with a slight swelling in their mouth, accompanied by an increased evacuation of saliva. The limpid fluid also which the Toad suddenly ejects from his body when disturbed, has been ascertained to be perfectly free from any noxious qualities whatever: it is merely a watery liquor, the contents of a peculiar reservoir, that, in case of alarm, appears to be emptied in order to lighten the body, that it may the more readily escape[*]. It is its extremely forbidding aspect only that has obtained for the Toad its present unjust character of being a poisonous animal. He is on this account persecuted and murdered wherever he appears, on the supposition merely, that, because he is ugly, he must in consequence be venomous. Its eyes are, however, proverbially beautiful, having a brilliant reddish gold-coloured iris surrounding the dark pupil, and forming a striking contrast with the remainder of its body[†]: hence Shakespere, in Romeo and Juliet, remarks,

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* Stedman.

† Rana Bufo. *Linn.*—*Shaw's Gen. Zool. vol.* 3. *tab.* 40.

Some say the Lark and loathed Toad change eyes.

Its reputation as a poisonous animal obtained for it, among the superstitious, many preternatural powers; and the reputed dealers in magic art are reported to have made much use of it in their compounds. This circumstance caused it to be inserted among the ingredients adopted by the witches in Macbeth to raise the spirits of the dead:

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[*] Townson's Tracts. [†] Shaw's Gen. Zool. iii. 138.

Toad that under the cold stone
Days and nights has thirty-one
Swelter'd venom, sleeping got,
Boil thou first i' th' charmed pot.

It is no difficult task, singular as it may appear to those who never attended much to this animal, to render it quite tame, so that it may be taken in the hand, and carried about a room to catch the flies that alight on the walls. A correspondent of Mr. Pennant gave him some curious particulars of a domestic Toad, which was remarked to continue in the same place for upwards of *thirty-six* years. It frequented the steps before the hall-door of a gentleman's house in Devonshire. By being constantly fed, it was rendered so tame as always to come out of its hole in an evening when a candle was brought, and look up, as if expecting to be carried into the house, where it was frequently fed with insects. An animal that is so generally detested, being so much noticed and befriended, excited the curiosity of all who came to the house; and even the females so far conquered the horrors instilled into them by their nurses, as generally to request to see it fed. It appeared most partial to flesh maggots, which were kept for it in bran. It would follow them on the table, and, when within a proper distance, would fix its eyes and remain motionless for a little while, apparently to prepare for the stroke, which was instantaneous. It threw out its tongue to a great distance, and the insect stuck by the glutinous matter to its tip, and was swallowed by a motion quicker than the eye could follow. This it was enabled to do, from the root of the tongue (as in the Frog) being attached to the fore-part of the mouth, and lying when at rest with the tip towards the throat. After being kept above thirty-six years, it was at length destroyed by a tame raven, which one day seeing it at the mouth of its hole, pulled it out, and so wounded it, that it died not a great while afterwards*.

The Spider was formerly considered an inveterate enemy to the Toad, and it has been said that whenever they met a contest always took place, in which, from its superior dexterity and address, the former often proved victorious. If this relates to the European Spiders and Toads, it is, most surely, altogether devoid of foundation.

In the conclusion of this article it may be expected that we should not leave entirely unnoticed the observations that have been made respecting living Toads being found inclosed in solid substances.—Though it is necessary that we should make some allowances for that natural love of the marvellous which pervades the great mass of mankind, yet we have too many respectable authorities to vouch for the fact, and too frequent instances of its recurrence, to allow us to doubt that these animals have been discovered alive in blocks of stone, and in the solid trunks of trees.

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* Penn. Brit. Zool. App. vol. iii. p. 380—388.

To account for so extraordinary a phenomenon, a French writer, M. Lecat, says that some philosophers have been of opinion, that the eggs of these animals, created at the beginning of the world, and floating about on the watery expanse, have since that time been inclosed in the interior parts of rocks. But he contradicts this opinion by remarking, that the creation of an egg is not sufficient; and that it must be hatched in order to produce a living creature. He considers it also as impossible that such animals can be as old as the stones or substances in which they are found; and rather thinks that a hatched egg, in all the cases mentioned, may have fallen by chance into some small cavity where it was secured from petrifaction. He remarks that eggs, when rubbed over with varnish so as to be defended from the effects of the air, may be preserved fruitful for years; and, therefore, believes that an egg so secured in the centre of a rock might retain its activity for thousands of years: hence he concludes that the egg is of great antiquity, but not the animal*.

At a period like the present, when so many things are made the subject of experiment, and nature is compelled as it were to discover her most hidden secrets, it is somewhat surprising that she has not been put to the proof in this respect. Such experiments would require little or no expense: it would only be necessary to make a deep hole in a stone, inclose some animal in it, and prevent the air from penetrating it; or eggs only might be put into the stone. As most of the animals found in stones are of the amphibious kind, it would be proper to study the habits, nature, and mode of living peculiar to that class; and it would be attended with most advantage if several experiments were made at the same time, in order that the state of the animals at different periods might be examined. By these means alone some certain conclusions might be drawn, respecting a circumstance which at present seems to surpass the powers of comprehension.

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* Mélanges d'Histoire Naturelle, vol. iv.

THE PIPA*.

The Pipa is a native of Surinam, and at first view appears an extremely hideous and deformed animal. It is considerably larger than our Toad, has a flattish body, and a somewhat triangular head. The mouth is very wide, and furnished at the edges or corners with a kind of cutaneous appendage. The fore-feet have four long and thin toes, each divided at the tip into four distinct parts, which, when inspected with a magnifier, are found to be each again obscurely subdivided almost in a similar manner. The hind-feet have five toes united by a web. The male is larger than the female.

This creature, in the production of its young, affords a very singular deviation from the usual course of nature. On the back of the female are formed certain cavities, opening outward, and somewhat resembling the cells of a bee-hive. They are of a circular form, about half an inch deep, and each nearly a quarter of an inch in diameter. They are at a little distance from each other, and somewhat irregularly ranged. At a certain period of incubation, if it may be so called, in each of these shells is found a little live Toad, an exact miniature in all respects of its parent; but how it finds subsistence there (for the creature has no adhesion to the parent, but may be easily taken out, as from a case, and again replaced without injury) does not seem as yet to be fully ascertained. Mr. Ferman, who has described this animal, declares himself to have been an eye witness to the procedure. The eggs are generated within the female, who, when they have attained the proper degree of maturity, deposits them on the ground. The male amasses together the heap, and deposits them, with great care, on the back of the female, where after impregnation they are pressed into the cellules, which are at that period open for their reception, and afterwards close over them. The ova remain in the cellules till the second birth, which takes place in somewhat less than three months, when the young emerge from the back of the parent, completely formed. During the time of concealment they undergo the usual change of the rest of the genus, into the tadpole state, which they entirely put off before their final extrusion.

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* SYNONYMS.—Rana Pipa. *Linn.*—Surinam Toad.——*Shaw's Gen. Zool. vol. 3. tab. 50, 51.*

In this singular production of young, the Pipa seems to bear considerable analogy to the different species of Opossum.

Ferman says that the Pipa is only calculated for having one breed. The number of young produced by a female that he observed was seventy-five; and they were all perfected in the space of five days after the first appeared*.

THE LIZARD TRIBE.

THE Lizards, from, in many instances, an unpleasant appearance, have, with the Toad, obtained the repute of being venomous. The whole tribe is however perfectly destitute of poison, and, except in three or four of the enormously large species, altogether inoffensive.

They are chiefly inhabitants of the warmer regions, and in general possess considerable agility. The larger ones live on animals which they seize by stratagem, and the smaller ones on insects. Many of them serve mankind for food. The aquatic species undergo a metamorphosis, being first in a larva state. Most of them are produced from eggs externally, but some are brought forth alive. In this genus are found nearly the largest and the smallest animals in the creation.

The body is elongated, naked, and furnished with a tail and four equal legs.

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* Anderson's Recreations, ii. 32.—Shaw's Gen. Zool. iii. 167.

CROCODILE *.

The Crocodile is an animal perhaps too commonly found near the large rivers in various parts, both of Asia and Africa, where it attains the amazing length of twenty-five feet and upwards. The armour with which the upper part of the body is coated, may be numbered among the most elaborate pieces of Nature's mechanism. In the full-grown animal it is so strong as easily to repel a musquet-ball: on the lower parts it is much thinner and more pliable. The whole animal appears as if covered with the most regular and curious carved work. The colour of the full-grown Crocodile is blackish-brown above and yellowish-white beneath. The upper parts of the legs and sides are varied with deep yellow, and in some parts tinged with green. The eyes are provided with a winking membrane, as in the bird tribes. The mouth is of vast width, and furnished with numerous sharp-pointed teeth, thirty or more on each side of the jaws; and these are so disposed as, when the mouth is closed, to fit alternately above and below.

The Crocodile and Alligator have the largest mouths of almost any animals, and, in addition to this, have both the upper and under jaw moveable. They are generally supposed to have no tongue, but this is erroneous; for the tongue in each is larger than that of the Ox; but it is so connected with the sides of the

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* SYNONYMS.—Lacerta Crocodilus. *Linn.*—Cayman. *Bosman.*—Nilotic Crocodile. Common Crocodile. *Shaw.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 55, 56, 57.

lower jaw, as to be incapable of being stretched far forwards, as in other animals.

Except when pressed by hunger, or with a view of depositing its eggs, this enormous creature seldom leaves the water. Its usual method is to float along upon the surface, and seize whatever animals come within its reach; but, when this method fails, it then goes closer to the bank. There it waits in patient expectation of some land animal that may come to drink; the dog, the bull, the tiger, or man himself. Nothing is to be seen on the approach, nor is its retreat discovered till it is too late for safety. It seizes the victim with a spring, and goes at a bound much farther than such an unwieldy animal could be supposed to do. Then having secured the prey, it drags it into the water, instantly sinks with it to the bottom, and in this manner quickly drowns it. Sometimes it happens that the creature wounded by the Crocodile makes its escape; in which case, the latter pursues with some celerity, and often takes it a second time. He seldom moves far from rivers except in covert and marshy places; so that, in many parts of the East, it is very dangerous to walk carelessly on the banks of unknown rivers, or among sedgy grounds; and still more so to bathe, without the utmost circumspection, in unfrequented places. He seldom pursues his prey far on shore; and although his pace is tolerably rapid in a direct line, yet he is not sufficiently swift to overtake an active man who preserves his presence of mind.

All the rivers of Guinea are pestered with vast shoals of Crocodiles. On very hot days, great numbers of them lie basking on the banks of rivers, and as soon as they observe any one approach their place they plunge in with great violence.

Bosman says, very quaintly, "As for their crying "and subtelties to catch men, I believe them as much "as the Jews do the Gospel *."

They are excessively voracious, and swallow all their food whole; for their mouth is neither furnished with grinding teeth, nor have the jaws any lateral motion. They are said to swallow stones to aid digestion, in the manner of the seed-eating birds; and they are able to sustain abstinence for many weeks together.

The young are produced from eggs deposited in the sand, and hatched by the heat of the sun, near the bank of some river or lake. The female is said to be extremely cautious in depositing them unobserved: the general number is from eighty to a hundred: they are not larger than those of a Goose, and are covered with a tough white skin. She fills up the hole carefully before she leaves them. In each of the two succeeding days she lays as many more, which she hides in the same manner. The eggs are hatched generally in about thirty days, when the young immediately run into the water: these are devoured by various kinds of fish, and their numbers are also lessened by supplying food to their own species. It is however in the destruction of their eggs that the most material service is effected. The Ichneumon † and the Vultures, which are here found in immense num-

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* Bosman's Guinea, 239. † Viverra Ichneumon of Linnæus.

bers, seem peculiarly appointed by Providence to abridge their enormous fecundity, and in this capacity devour and destroy millions of the eggs.

Crocodiles are frequently seen about the rivers in Java in great numbers. The Javanese sometimes catch them with a hook and line; a circumstance that at first would seem almost incredible, since they can, with great ease, bite asunder the strongest rope. These people therefore use a very loosely twisted cord of cotton, at the end of which a hook is fastened, baited with raw flesh. When the Crocodile, after having swallowed the hook, endeavours to bite the cord asunder, his teeth only separate the fibres, and all his attempts are of no avail. When he is found to be fastened, his antagonists come upon him in great numbers, and, with the weapons they have for the purpose, soon destroy him*.

In other parts of the world they are hunted by means of strong dogs properly trained, and armed with spiked collars.

The natives of Siam take Crocodiles by placing three or four strong nets across a river, at proper distances from each other; so that, if the animal breaks through the first, he may be caught in some of the others. When he finds himself fastened, he lashes every thing around him with great violence with his enormous tail. After he has struggled some time, and is become exhausted, the men approach in boats, and pierce him in the most tender parts of his body with spears.

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* *Thunberg*, ii. 290.

Labat assures us, (but whether his assertion is to be trusted or not, we cannot say,) that a negro armed only with a knife in his right hand, and his left wrapped round with thick leather, will venture boldly to attack the Crocodile in his own element. As soon as he observes his enemy near, the man puts out his left arm, which the beast immediately seizes in its mouth. He then gives it several stabs below the chin, where the skin is very tender; and the water coming in at the mouth, thus involuntarily held open, the creature is soon destroyed.

The Crocodile, from its immense size and voracious habits, is certainly an object of fear; and, by no very uncommon transition of sentiment, has also gradually become an object of veneration; and offerings are in some countries made to it as to a deity. The inhabitants of Java, when attacked by disease, will sometimes build a kind of coop, and fill it with such eatables as they think most agreeable to the Crocodiles. They place the coop upon the bank of a river or canal, in the perfect confidence that, by the means of such offerings, they shall get rid of their complaints; and persuaded that, if any person could be so wicked as to take away those viands, such person would draw upon himself the malady, for the cure of which the offering was made. The worship of Crocodiles was indeed a folly among men of antient date; as Herodotus expressly says, that "among some of the Egyptian tribes the "Crocodiles are sacred, but that they are regarded as "enemies among others. The inhabitants in the "environs of Thebes, and the lake Mœris, are firmly "persuaded of their sanctity; and both these tribes "bring up and tame a Crocodile, adorning his ears "with rings of precious stones and gold, and putting "ornamental chains about his fore-feet. They also "regularly give him victuals, offer victims to him, "and treat him in the most respectful manner while "living, and, when dead, embalm, and bury him in a "consecrated coffin."

It is said that even at this day Crocodiles are occasionally tamed in many parts of Africa, where they are kept in large ponds or lakes, as an article of magnificence with the monarchs of those regions. The Romans frequently exhibited these animals in their public spectacles and triumphs.

The eggs of the Crocodile are numbered among the delicacies of some of the African tribes, and are said to form one of their most favorite repasts.

One of the greatest curiosities in the fossil world, which the late ages have produced, is the skeleton of a large Crocodile, almost entire, that was found at a great depth under ground, bedded in stone. This was in the possession of Linkius, who wrote many tracts on natural history, and particularly an accurate description of this curious fossil. It was found in the side of a large mountain in the midland part of Germany, in a stratum of black fossil stône, somewhat like our common slate, but of a coarser texture, the same with that in which the fossil fish in many parts of the world are found. This skeleton had the back and ribs very plain, and was of a much deeper black than the rest of the stone. The part of the stone where the head lay was not found: it was irregularly broken off just at the shoulder, so as, however, in one place, to leave part of the back of the head in its natural form. The two shoulder-bones were very fair, and three of the feet well preserved; the legs were of their natural shape and size, and the feet preserved, even to the extremities of the five toes of each.

ALLIGATOR[*].

The principal distinction betwixt the Alligator and the Crocodile is, that this has its head and part of the neck more smooth than the other, and that the snout is considerably more wide and flat, as well as more rounded at the extremity. The length of the full-grown Alligator is seventeen or eighteen feet.

The Alligators are natives of the warmer parts of America; and had it not been for an accident, these inhabitants of the New World would never have been known by any other name than that of Crocodile: for, had the first navigators seen any thing that more resembled their form than a Lizard, they would have adopted that by which the Indians call them, the *Cayman*; but the Spanish sailors remarking their great resemblance to that little reptile, they called the first of them which they saw, *Lagarto* or Lizard. When our countrymen arrived, and heard that name, they called the creature *a-Lagarto*, whence was afterwards derived the word *Alligato* or Alligator.

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[*] Synonyms.—Lacerta Alligator. *Linn.*—Jacare. *Marcgrave.*—Crocodile. *La Hontan.*—Lacertus maximus. *Catesby.*—American Crocodile.——*Shaw's Gen. Zool. vol.* 3. *tab.* 59.

They are often seen floating on the surface of the water like a log of wood, and are mistaken for such by various animals, which they by this means surprise, and draw down to devour at leisure. They are said also sometimes to form a hole in the bank of a river, below the surface of the water, and there to wait till the fish, that are fatigued with the strong current, come into the smooth water near to rest themselves, when they immediately seize and devour them*. But since they are not able to obtain a regular supply of food, from the fear in which they are held by all animals, and the care with which these, in general, avoid their haunts, they are able to sustain a privation of it for a great length of time. When killed and opened, stones and other hard substances are generally found in their stomach. In many that Mr. Catesby examined there was nothing but mucilage and large pieces of wood, some of which weighed seven or eight pounds each: the angles were so worn down that he fancied they must have lain there for several months†. Two alligators that Dr. Brickell saw killed in North Carolina, had in their bellies several sorts of snakes, some pieces of wood, and in one of them a stone that weighed about four pounds‡.

The voracity of these animals is so great that they do not spare even mankind when opportunity offers. A short time before M. Navarette was at the Manillas, he was told that as a young woman was washing her feet in one of the rivers, an Alligator seized and carried her off. Her husband, to whom she had been but that morning married, hearing her screams, threw himself headlong into the water, and, with a dagger in his hand, pursued the robber. He overtook, and fought him with such success, as to recover his wife: but she, unfortunately for her brave rescuer, in consequence of her fear, and the lacerations she had received, was found to be dead*.

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* Du Pratz, 268. † Catesby, ii. 63. Browne's Jamaica, 461.
‡ Brickell, 134.

They deposit their eggs, like the Crocodile and the Turtles, at two or three different periods, laying from twenty to about twenty-four at each time. It is said that those of Cayenne and Surinam raise a little billock on the bank of the river they frequent, and, hollowing it out in the middle, amass together a heap of leaves and other vegetable refuse, in which they deposit their eggs. This being also covered up with leaves, a fermentation ensues, by the heat of which, in addition to that of the atmosphere, the eggs are hatched. They generally lay their eggs in the month of April†. Multitudes of these are destroyed by the Vultures, and immense numbers of the young animals are devoured, as soon as they reach the water, by the various species of fish.

It appears that the Alligator, when taken very young, may be in some measure domesticated. Dr. Brickell saw one that was taken not long after being hatched, and put into a large pond before a planter's house. It remained near half a year, during which time it was regularly fed with the entrails of fowls, and raw meat. It frequently came into the house, where it would remain for a short time, and then return again to its shelter in the pond. It was supposed at last to steal away to a creek near theplantation; for it was one day missing, and from that time was never afterwards seen*.

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* Navarette's Travels, Churchill's Coll. ii. 263.

† M. de la Borde, quoted in Shaw's Gen. Zool. iii. 196.

Their voice is very loud and dreadful, being stronger than even the roar of a bull. They have an unpleasant and very powerful musky scent: M. Pagés says, that near one of the rivers in America, where the Alligators were very numerous, the effluvia was so strong as to impregnate their provisions, and even to give them the nauseous taste of rotten musk†.

The teeth are as white as ivory, and chargers for guns, snuff-boxes, and several kinds of toys are made with them. Those who have eaten of their flesh say that it is white and very delicious: many of the American tribes are in a great measure supported by it.

COMMON GUANA‡.

This is an animal that frequently occurs in America, and both the West and East Indies, where it grows to four or five feet in length. The tail is long and round; the back serrated; and the crest denticulated. The individuals vary greatly in colour, but their prevailing tinge is a brownish green. Under the chin there is a pouch capable of great inflation.

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* Brickell, 134. † Pagés, i. 48.

‡ SYNONYMS.——Lacerta iguana. *Linn.*—Leguana. *Seba.*—Great American Guana. Common Guana. *Shaw.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 61.

It inhabits the rocks, and hides itself in cliffs or hollow trees. Its food is almost entirely confined to vegetables and insects, which it swallows whole; and the fat of the abdomen assumes the colour of whatever the animal has last eaten. Its appearance is disgusting, and its motions very slow, "their holes," says Catesby, "being a greater security than their heels." Though not naturally amphibious, it will on necessity continue long under water: in swimming it keeps its legs close pressed to its body, and urges itself forward by means of the tail.

They constitute a principal support of the natives of the Bahamas, who go out in their sloops to other islands to take them, which they do by means of dogs trained for the purpose. As soon as caught their mouths are sewed up, to prevent them from biting, and some are carried alive from hence to Carolina for sale; others are salted and barrelled for home consumption*.

They constitute a most favorite food to the natives. Father Labat speaks highly of its delicacy and fine flavor, and describes the mode in which he, and some others that were along with him, saw one of them taken. "We were attended (he says) by a negro who carried a long rod; at one end of which was fastened a piece of whipcord with a running knot. After beating the bushes for some time, the negro discovered our game, basking in the sun, on the dry limb of a tree. On this he began whistling with all his might; to which the Guana was wonderfully attentive, stretching out his neck, and turning his head, as if to enjoy it more fully. The negro now approached still whistling: and, advancing his rod gently, began tickling with the end of it the sides and throat of the Guana, which seemed mightily pleased with the operation; for he turned on his back, and stretched himself out like a cat before the fire, and at length fairly fell asleep. The negro perceiving this, dexterously slipped the noose over his head, and with a jerk brought him to the ground."

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* Catesby, ii. 64.

The flesh is sometimes roasted, but more usually boiled, the fat being first taken out, which the natives melt and clarify.

The Guana is an animal easily tamed if taken young. Dr. Browne kept a full-grown one about his house for more than two months: at first it was very fierce and ill-natured; but after some days it grew more tame, and would, at length, pass the greatest part of the day on the bed or couch: but it always went out at night. As it walked along it frequently threw out its forked tongue; but Dr. Browne says that during all the time he had it he never observed that it ate any thing*.

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* Browne's Jamaica, 462.

SCALY LIZARD*.

The scaly Lizard is one of the British species. Its general length, from the nose to the end of the tail, is about six inches and a half. The upper part of the head is light brown, and the back and tail are variously striped and spotted with light brown, black, white, and dark brown. The under parts of the body are of a dirty white.

It is an extremely active little creature, basking in hot weather on the sides of dry banks or about roots of old trees; but on being observed it instantly retreats to its hiding-place.

Its food is chiefly insects, which it pursues with great celerity: but Mr. Edwards once surprised one of these Lizards in the act of fighting with a small bird that sate on her nest in a vine against a wall, with newly-hatched young. He supposed that the Lizard would have made them a prey, could he but have got them out of the nest. He watched the contest for some time; but on his near approach the Lizard dropped to the ground, and the bird flew off †.

These animals are themselves a prey to many of the feathered tribe. When an attempt is made to seize them, they generally effect an escape with considerable address. The tail is very brittle, often snapping off with the least roughness in handling them.

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* SYNONYMS.—Lacerta agilis. *Linn.*—Little brown Lizard. *Edwards.*—Scaly Lizard. *Penn.*—*Penn. Brit. Zool. vol. 3. tab. 2.*

† Edwards, i. 34.

If taken and kept in a room, they may be in a great measure rendered tame and familiar.

GREEN LIZARD OF CAROLINA*.

These beautiful little animals are about five inches in length, and of a dusky green colour. The male has a red expansile pouch beneath his chin.

They frequent the houses in Carolina, and are suffered with impunity to sport on the tables and windows; which they do with great dexterity, and in a very diverting manner. The summer is the time when they are principally seen; for at the approach of cold weather they retreat to their recesses in the hollows and crevices of decayed trees, where they lie in a torpid state through the winter.

They are sometimes known to change their colour very suddenly: in a hot day they are seen of a green colour; but if on the following day the weather becomes cold, the same animals will often appear brown.

It frequently happens that a few warm sunny days, in the early part of spring, so invigorate them, that they come out of their winter retirements. If the weather suddenly changes to cold, they are so enfeebled as to incapacitate them from again seeking their retreats, and they die of cold.

Cats and the ravenous birds prey upon them†.

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* Lacerta bullaris. *Linn.*——† Catesby, ii. 65.

CHAMÆLEON*.

The Chamæleon is a native of India, Africa, and some of the warmer parts of Spain and Portugal. The usual length of its body is about ten inches, and that of the tail is nearly the same.

It is perfectly harmless, feeding only on insects, for which the structure of its tongue is peculiarly adapted, being long and missile, and furnished with a dilated, glutinous and somewhat tubular tip. By means of this it seizes insects with the greatest ease, darting it out and instantaneously retracting it, with the prey secured on its tip, which it swallows whole. The skin is covered with small warts or granulations, and down the middle of the back it is serrated. The feet have five toes united three and two to enable it to lay firmly hold of the branches of trees, in which it principally resides; and to this end also its tail is prehensile, and is always coiled round the branch till the animal has secured a firm footing. Its motions are extremely slow. The lungs are so large as to allow it to inflate the body to a vast size. The structure and motions of its eyes are very singular: these are large and globular, and so formed that at the same instant it can look in different directions. One of them may frequently be seen to move when the other is at rest; or one will often be directed forwards, while the other is attending to some object behind, or in the same manner upwards and downwards.

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* Lacerta Chamæleon. *Linn.*—*Shaw's Gen. Zool. vol.* 3. *tab.* 76.

The Chamæleon is principally celebrated for the singular property that it possesses of occasionally changing its colour. Not having ourselves witnessed this operation, we shall present the reader with the accounts of three persons who have : there appears a considerable difference in the relations, which the reader must reconcile as well as he is able. The writers we here allude to are D'Obsonville, Hasselquist, and Dr. Russel.

The colour of the Chamæleon, says D'Obsonville, is naturally green, but it is susceptible of many shades, and particularly of three very distinct ones; Saxon green, deep green, and a shade bordering on blue and yellow green. When free, in health, and at ease, it is a beautiful green, some parts excepted, where the skin, being thicker and rougher, produces gradations of brown, red, or light grey. When the animal is provoked, in open air, and well fed, it becomes blue-green; but when feeble, or deprived of free air, the prevailing tint is the yellow-green. Under other circumstances, and especially at the approach of one of its own species, no matter of which sex, or when surrounded and teased by a number of insects thrown upon him, he then, almost in a moment, takes alternately the three different tints of green. If he is dying, particularly of hunger, the yellow is at first predominant; but in the first stage of putrefaction this changes to the colour of dead leaves.

It seems that the causes of these different varieties are several: and first, the blood of the Chamæleon is of a violet blue, which colour it will preserve for some minutes on linen or paper, especially on such as have been steeped in alum-water. In the second place, the different tunicles of the vessels are yellow, as well in their trunks as in their ramifications. The epidermis, or exterior skin, when separated from the other, is transparent, without any colour; and the second skin is yellow, as well as all the little vessels that touch it. Hence it is probable that the change of colour depends upon the mixture of blue and yellow, from which result different shades of green. Thus, when the animal, healthy, and well fed, is provoked, its blood is carried in greater abundance from the heart towards the extremities, and, swelling the vessels that are spread over the skin, its blue colour subsides the yellow of the vessels, and produces a blue green that is seen through the epidermis. When, on the contrary, the animal is impoverished and deprived of free air, the exterior vessels being emptier, their colour prevails, and the animal becomes a yellow-green till it recovers its liberty, is well nourished, and without pain, when it regains the colour; this being the consequence of an equilibrium in the liquids, and of a due proportion of them in the vessels *.

Hasselquist says, that he never observed the Chamæleon assume the colour of an external object presented to its view, although he made several experiments for the purpose. He says its natural

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* D'Obsonville, 35.

colour is an iron grey, or black mixed with a little grey. This it sometimes changes, and becomes entirely of a brimstone-yellow, which, except the former, is the colour it most frequently assumes. It sometimes takes a darker or greenish yellow, and sometimes a lighter. He did not observe it assume any other colours, such as blue, red, purple, &c. When changing from black to yellow, the soles of its feet, its head, and the bag under its throat, were the first tinged, and then by degrees that colour spread over the rest of the body. He several times saw it marked with large spots of both colours all over its body, which gave it an elegant appearance. When it became of an iron grey it dilated its skin, and became plump and handsome; but as soon as it turned yellow, it contracted itself, and appeared empty, lean and ugly: and the nearer it approached in colour to white, the more empty and ugly it appeared; but its shape was always the most unpleasant when it was speckled. Mr. Hasselquist kept a Chamæleon for near a month; it was during the whole time very nimble and lively, climbing up and down its cage, fond of being near the light, and constantly rolling about its large eyes. It took no food during the whole of this time, so that at last it became lean, and evidently suffered from hunger. It could no longer hold fast by the grating of the cage, but fell through weakness, when a turtle that was in the same room bit it and hastened its death. From its being able to support long abstinence the vulgar notion has arisen of the Chamæleon's living only on air *.

When the Chamæleon is removed from its place, Dr. Russel also informs us that it does not immediately change colour, nor does it constantly in changing assume that of the ground upon which it is laid. Thus, if put into a box lined with white, or with black, it will sometimes in the black become of a lighter colour than before, and vice versa; and sometimes will assume a brimstone colour. When the experiment was made upon a cloth of various colours, but where the animal had a larger field to move about, the event was the same.

It frequently goes through a ſuccession of colours before taking that of the body neareſt it. When laid on the graſs, it will perhaps, from a light earthy colour, first become darker, then black, yellow, again darkish, and last of all green. At other times it becomes green at once; and so of other colours when laid on other grounds: whence it was hastily believed that the transition was always sudden. But, notwithstanding this irregularity in its change, especially when hurried or disturbed, its most permanent colour in repose was that of the ground on which it lay, provided the ground was not of one of the colours that it never does assume, of red or blue. Little material difference was observable, whether the experiments were made in the shade or

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* Hasselquist, 217.

in the sun; but the animal appears duller at some times than at others, and captivity seems to abate its alacrity in changing*.

Mr. Barrow says that "previous to the Chamæleon's assuming a change of colour, it makes a long inspiration, the body swelling out to twice its usual size; and, as this inflation subsides, the change of colour gradually takes place. The only permanent marks are two small dark lines passing along the sides†."

OFFICINAL SCINK ‡.

This species of Lizard, which is generally six or seven inches in length, is found in great numbers in the sandy plains of Egypt, Libya, Syria and Arabia.

The head is not very large, scarcely thicker than the neck. The body is cylindrical, and the tail not long, and ending in a compressed tip. The body is covered with small scales, and is of a pale yellowish brown colour, with a few broad, dusky, transverse bands. The scales lie so close as to give the surface a glossy or oily appearance.

In its manners this little animal is exceedingly harmless, supporting itself principally on insects. Mr. Bruce says that it burrows in the sand, and performs this operation so quickly, that it is out of sight in an instant, and appears rather to have found a hole than to have made one. It often comes out in the heat of the day to bask in the sun; and, if not very much frightened, will take refuge behind stones, or in the withered ragged roots of the Absynthium, dried in the sun to nearly its own colour. It runs with very great celerity.

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* Russel's Natural History of Aleppo.

† Barrow's Travels in Africa.

‡ SYNONYMS.—Lacerta Scincus. *Linn.*—El Adda. *Bruce.*—Common Scink. Officinal Scink. *Shaw.*——*Shaw's Gen. Zool. vol. 3. tab. 79.*

This is one of the few Lizards which the Arabs in all times have believed to be free from poisonous qualities, and yet to have all the medical virtues so abundantly lavished upon the more noxious species. It was in high estimation in Europe, as well as in the eastern climates, as a valuable article in the Materia Medica. It is not however at present considered here as of any importance, and even amongst the Arabs its character is greatly on the decline.

This, and others of the Lizard tribe, are so numerous in the East, that Mr. Bruce is positive the number he one day saw in the great court of the temple of the Sun at Balbec amounted to several thousands. The ground, the walls and stones of the ruined buildings were covered with them; and their various colours made a very extraordinary appearance, from their glittering under the sun, in which the animals lay sleeping and basking.

SALAMANDER*.

No one of the present tribe, except the Crocodile, has been more frequently spoken of than the Salamander. It is found in shady woods in many parts of Germany, Italy and France, and is easily distinguished by its short cylindrical tail, and deep shining black colour, variegated with large oblong and somewhat irregular patches of bright orange-yellow. Its general length is seven or eight inches, though sometimes it becomes much larger.

Whilst the hardest bodies are unable to resist the action of fire, the generality of mankind have given full credit to the ridiculous stories that have for ages been circulated of this little Lizard not only being able to withstand its effects, but even to extinguish it. So small an animal possessing such very superior privileges, that furnished so many objects of comparison to poetry, so many pretty emblems to love, and so many brilliant devices to valour, seems to have agreeably laid hold on the imaginations of men in such a manner, that they were unwilling to retract their belief, and therefore contented themselves with the traditions, without having their curiosity sufficiently roused to satisfy themselves by immediate experiment. The antients, pretending that it owed its existence to the purest of elements, called it the Daughter of Fire, giving it at the same time a body of ice. The moderns adopted the ridiculous tales of the antients ; and as it is difficult to stop when once the bounds of probability have been passed, some writers have gone so far as to assert, that the most violent fire could be extinguished by the Salamander : in the most raging conflagration, it has been said, if one of these small Lizards was but thrown in, its progress would be immediately checked : and it was not till after the light of science was diffused abroad, that the world began to discredit this wonderful property. Experiment then proved what reason alone might long before have demonstrated.

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* Lacerta Salamandra. *Linn.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 82.

In addition to this, the Salamander was esteemed a poisonous reptile, and has been generally held in terror : but this opinion has been refuted by numerous experiments. M. de Maupertuis, who studied the nature of this Lizard, in order to discover what might be its pretended poison, demonstrated also experimentally that fire acted upon it in the same manner as upon all other animals. He remarked, that it was scarcely upon the fire before it appeared to be covered with the drops of a kind of milky fluid which oozed through all the pores of the skin, and immediately became hard. It is needless to say that this fluid is not sufficiently abundant to extinguish even the smallest fire : it possesses some degree of acridity, for when put upon the end of the tongue it causes an unpleasant burning sensation.

Shady woods, high mountains, or the banks of unfrequented rivulets, are the usual retreats of these animals ; and they are not often seen except during wet weather. In the winter they lie concealed in hollows about the roots of old trees, in subterraneous recesses or the cavities of old walls, where several of them have been sometimes discovered, collected and twisted together. They are often to be seen in the water, where they are able to live as well as on land. Their principal food is insects, snails, &c. Their pace is slow, and in manners they are very sluggish.

Their young are brought into the world alive, having been first hatched from eggs within the parent animal. They are said to retire to the water to deposit them: at their first exclusion from the body, these are furnished with fins on each side of the neck, which, on their becoming perfect animals, drop off. The number of young produced by one Salamander is said sometimes to amount to thirty or forty.

THE WARTY LIZARD*.

This Lizard, which is very common in stagnant waters in this country, is six or seven inches in length, and entirely covered, except on the belly, with small warts. The under parts are of a bright yellow colour, and the upper mostly black brown, spotted with black. It resides altogether either in the water, or in very damp places, and its tail, being flattened perpendicularly, serves it as a rudder in swimming. It is usually seen crawling along the bottom, but it now and then rises, with a wriggling motion, to the surface.

At certain periods these animals, like many other reptiles, change their skins. Mr. Baker kept some of them in a large jar of water for many months, and found that they generally performed this operation at the end of every fortnight or three weeks.

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* Lacerta palustris. *Linn.*

A day or two before the change, the animal always appeared more sluggish than usual, taking no notice of the worms that were given to it, which at other times it greedily devoured. The skin in some parts of the body appeared loose, and its colour not so lively as before. It began the operation of casting the skin, by loosening that part about the jaws; it then pushed it backward gently and gradually, both above and below the head, till it was able to slip out first one leg and then the other. With these legs it proceeded to thrust the skin as far backwards as they could reach: this done, it was under the necessity of rubbing its body against the gravel, till it was more than half freed from the skin, which appeared doubled back, and covering the hinder part of the body and the tail. The animal now bent back its head, taking the skin in its mouth, and, setting its feet upon it, for firmer hold, by degrees drew it entirely off, the hind-legs being dragged out in the same manner that the fore ones were before.

On examining the skin it was in every instance found to be turned with its inside outwards, but without any breach except at the jaws. These creatures do not, however, like some of the snakes, put off the coverings of the eyes along with the skin; for two round holes always appear where the eyes have been.

This operation sometimes occupies near half an hour; and after it is finished, the Lizard appears full of life and vigour. If the skin is not taken away very shortly after it is cast, the animal usually swallows it whole as it does other food. Sometimes it begins with the head part first; and the tail being filled with air and water becomes like a blown bladder, and proves so unmanageable, that it is very diverting to see the pains it costs to discharge these, and to reduce it to a condition to be got down the throat *.

Dr. Townson, who had several of these Lizards in a jar for the purpose of trying experiments on their respiration, says that he fed them with worms, and that if they were in the greatest stillness, and a worm was dropped ever so gently among them, they all immediately began to fight, each attacking his neighbour, and seizing it by the head, foot, or tail. This he remarked to be not a contention immediately for the worm, for that often lay for a short time unnoticed, but it seemed to originate from a great acuteness of smell, which in a moment informed them of the presence of their food, and from a singular dullness in their discriminating powers †.

Being never seen in winter, they are supposed to retire into holes or mud, and become torpid. They deposit their spawn in small clusters, consisting of several palish yellow-brown globules included in surrounding gluten. The larvæ are furnished with fins on each side of the breast, which fall off when the animals attain a perfect state.

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* Paper of Mr. Baker in Phil. Tran. vol. xliv. p. 529.

† Townson's Tracts, p. 113.

THE SERPENTS*.

THERE is much geometrical elegance in the sinuous motions of the Serpent tribe. Their backbone consists of moveable articulations, and runs through the whole length of their body. The breast and abdomen are surrounded with ribs. Some of the species can make their bodies stiff, and by this means are enabled to spring with great force and velocity on their prey.

The bodies of most of the tribes are covered with scales; and Linnæus has endeavoured to mark the species by the number of scaly plates on the abdomen and beneath the tail, the former of which he denominates *scuta*, and the latter subcaudal *squamæ:* but every day's experience tends to prove that these are too uncertain and variable to be depended on.

The head is connected to the trunk without the intervention of a neck. Their jaws are so formed that the animals are able to swallow bodies as thick and frequently even thicker than themselves. The tongue is slender and cleft.

The *poisonous* Serpents differ from the others by having long tubular fangs on each side of the head, calculated to convey the venom from the bag or receptacle at the base into the wound made by their bite. The principal distinguishing rule in these tribes is, that the venomous Serpents have only two rows of true or proper teeth (that is, such as are not fangs) in the upper jaw, whilst all others have four.

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* This is the second Linnean Order of the Amphibia.

A head entirely covered with small scales is also in some degree a character, but by no means an universal one, of poisonous species; as are also scales on the head and body furnished with a ridge or prominent middle line. The number of poisonous Serpents is very few when compared with the whole number of the species. Out of about 230 species described in *Systema Naturæ* there are not 40 that have been discovered to possess the poisonous fangs.

All the species cast their skins at certain periods; and those of cold and temperate climates lie concealed in a torpid state during winter. The flesh of several of the Serpents is innoxious, and even eaten by the natives of many countries. Some of them deposit eggs, which are connected in a kind of chain; and others produce their young perfectly formed from eggs hatched within their bodies.

THE RATTLE-SNAKE TRIBE.

The animals of this tribe, which are very few, are all furnished with poisonous fangs, but their bite is not fatal unless they are much irritated. They are confined to the warmer parts of America, where they prey on the smaller birds, lizards, &c. They give notice of their approach by the rattle at the end of their tail, which is composed of hollow membranaceous articulations, that annually increase in number till they amount to about forty. The head is broad, and covered with large carinated scales, or such as have a prominent middle line: the snout is rounded and obtuse. Their Linnean generic character is, that they have scuta on the abdomen; scuta and squamæ beneath the tail, and the tail terminated with a rattle.

THE BANDED RATTLE-SNAKE*.

This, the most dreaded of all the Serpents, is found both in North and South America, where it usually grows to about five or six feet in length. Its colour is yellowish-brown above, marked with broad transverse bars of black. Both the jaws are furnished with small sharp teeth, and the upper one has four large incurvated and pointed fangs. At the base of each is a round orifice, opening into a hollow, that appears again near the end of the tooth in the form of a small channel: these teeth may be raised or compressed. When they are in the act of biting, they force out of a gland near their roots the fatal juice: this is received into the round orifice of the teeth, conveyed through the tube into the channel, and from thence with unerring direction into the wound.—The tail is furnished with a rattle, consisting of joints loosely connected: the number of these is uncertain, depending in a great measure on the age of the animal, being said to increase annually by an additional joint.

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* SYNONYMS.—Crotalus horridus. *Linn.*—Rattle-snake. *Var.*

Providence has kindly given to mankind a security against the bite of this dreadful reptile; for it generally warns the passenger of its vicinity, by the rattling of its tail. In fine weather this notice is always given, but, however, not always in rainy weather: this gives the Indians a dread of travelling among the woods in wet seasons.

It moves with its head on the ground; but, if alarmed, throws its body into a circle, coiling itself with its head in the centre erect, and with its eyes flaming in a most terrific manner.——Happily it may be easily avoided; it is slow in pursuit, and has not the power of springing at its assailants*.

The tongue, like those of many other serpents, is composed of two long and round bodies joined together from the root to about half its length. This is frequently darted out and retracted with great agility. There is, besides the fangs with which they kill their prey, another kind of teeth, much smaller, and situated in both jaws, which serve for catching and retaining it. There are no grinders; for they do not chew their food, but always swallow it whole.

It is not very uncommon for this creature to come into houses; but the moment any of the domestic animals see or hear it they take alarm, and unite in giving notice of its presence. Hogs, dogs, and poultry, all exhibit the utmost consternation and terror, erecting their bristles and feathers, and expressing by their different notes of alarm that a dangerous enemy is near.—Mr. Catesby says, that in a gentleman's house of Carolina, as the servant was making the bed, on the ground floor, that he had himself left but a few minutes before, he discovered a Rattle-snake lying coiled between the sheets in the middle of the bed *.

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* Penn. Arct. Zool. ii. 336.

When the Rattle-snake has been irritated, or the weather is exceedingly hot, its poison, when inserted into a wound, often proves fatal in a very short time. In the Philosophical Transactions we have an account of several experiments that were made by captain Hall in South Carolina. A snake was tied down to a grass-plot, and made to bite a healthy cur-dog: immediately afterwards the poor animal's eyes were fixed, his teeth closed upon his tongue, which was hanging out, his lips were drawn up so as to leave his teeth and gums bare, and in a quarter of a minute he was dead. The hair was then taken off by means of hot water, and only one small puncture appeared, between his fore-legs, with a bluish-green colour round it.—A second dog was brought about half an hour afterwards, and the snake bit his ear: he exhibited signs of violent sickness, staggered about for some time, then fell down convulsed, and two or three times got up again: he lived near two hours.—Four days after this two

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* Catesby, ii. 41.

dogs, as large as common bull-dogs, were bitten by him: the one in the inside of his left thigh, which died exactly in half a minute; and the other on the outside of the thigh, which died in four minutes.—Captain Hall, after some other experiments, wished at last to prove whether its poison would prove mortal to itself. He therefore hung it up in such a manner that it had about half its length on the ground, and irritated it by two needles fastened to the end of a stick. The creature made several attempts to seize the stick, and then bit itself. It was let down, and in eight or ten minutes was found to be lifeless. The snake was afterwards cut into five pieces, which were successively devoured by a hog, but without receiving any injury in consequence.

We are told by an intelligent American writer, that a farmer was one day mowing with his negroes, when he by chance trod on a Rattle-snake, that immediately turned upon him, and bit his boot. At night, when he went to bed, he was attacked with a sickness; he swelled, and before a physician could be called in he died. All his neighbours were surprised at his sudden death, but the corpse was interred without examination. A few days after one of the sons put on his father's boots, and at night when he pulled them off he was seized with the same symptoms, and died on the following morning. The doctor arrived, but, unable to divine the cause of so singular a disorder, seriously pronounced both the father and the son to have been bewitched. At the sale of the effects a neighbour purchased the boots, and on putting them on experienced the like dreadful symptoms with the father and son: a skilful physician, however, being sent for, who had heard of the preceding affair, suspected the cause, and, by applying proper remedies, recovered his patient. The fatal boots were now carefully examined, and the two fangs of the snake were discovered to have been left in the leather with the poison-bladders adhering to them.—They had penetrated entirely through, and both the father and son had imperceptibly scratched themselves with their points in pulling off the boots *.

Dr. Brickell says he was a witness to an encounter between a Dog and a Rattle-snake which was fastened to the ground by a tolerably long string. The snake coiled up, and rattled its tail; and the dog being let loose seized, and attempted to shake it out at full length, but from the weight was prevented from doing it, and in consequence it bit him in the ear. He seemed somewhat stunned, and left the place, but returned on being encouraged by the company. In the second encounter he received a bite in his lip, after which the snake bit himself. The dog from that moment appeared senseless of every thing around him, even the caresses of his brutal master had now no effect, and in less than half an hour both the animals were found dead †.

A Rattle-snake which had been highly irritated by an Indian Dog, that had both cunning and agility enough always to keep out of his reach, was observed at the time to contract the muscles that moved his scales in such a manner as to make his body

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* Hector St. John, 238. † Brickell, 146.

appear extremely bright: but immediately after he had bitten himself all his splendour was gone [*].

If they are not provoked, these animals are perfectly inoffensive to mankind, being so much alarmed at the sight of men, as always, if possible, to avoid them, and never commencing an attack. Their anger is said to be easily known from the noise of their rattle, which in this state is always loud and distinct; but when they are pleased it is said to sound like a distant trepidation, in which nothing distinct can be heard. Negroes and others who have been bitten by them have also frequently recovered without any assistance; and indeed the Indian medicines are mostly so fanciful, that nature recovers many whose cure is attributed only to these.

Mr. St. John once saw a tamed Rattle-snake as gentle as it is possible to conceive a reptile to be. It went to the water and swam whenever it pleased; and when the boys, to whom it belonged, called it back, their summons was readily obeyed. It had been deprived of its fangs. They often stroked it with a soft brush: and this friction seemed to cause the most pleasing sensations; for it would turn on its back to enjoy it, as a cat does before the fire [†].

They are viviparous, producing their young, generally about twelve in number, in the month of June; and by September these acquire the length of twelve inches. It has been well attested, that they adopt the same mode of preserving their young from danger as that attributed to the European Viper, receiving them into their mouth and swallowing them.—M. de Beauvois declares that he was an eye-witness of the process. He saw a large Rattle-snake, which he had disturbed in his walks: it immediately coiled itself up, opened its jaws, and in an instant five small ones that were lying by it rushed into its mouth. He retired in order to watch the snake, and in a quarter of an hour saw her again discharge them. He then approached a second time, when the young rushed into its mouth more quickly than before, and the animal immediately moved off and escaped*.

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[*] Bartram's Obs. on Pennsylvania, 11.

[†] Hector St. John, 239.

The Rattle-snake is known to devour several of the smaller animals, and it has generally been believed, that it is endowed with the power of fascinating or charming its prey till they even run into its jaws. Mr. Pennant, from Kalm, says that the snake will frequently lie at the bottom of a tree on which a squirrel is seated. He fixes his eyes upon the little animal, and from that moment it cannot escape: it begins a doleful outcry, which is so well known that a person passing by, on hearing it, immediately knows that a snake is present. The squirrel runs up the tree a little way, comes downwards again, then goes up, and afterwards comes still lower. The snake continues at the bottom of the tree with his eyes fixed on the squirrel; with which his attention is so entirely taken up, that a person accidentally approaching may make a considerable noise without so much as the snake's turning about. The squirrel comes lower, and at last leaps down to the snake, whose mouth is already wide open for its reception. The poor little animal then with a piteous cry runs into his jaws, and is swallowed*.

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* Phil. Tran. vol. iv.

Some colour is given to this by M. Vaillant, who says, that he saw, on the branch of a tree, a bird trembling as if in convulsions, and at the distance of about four feet, on another branch, a large species of snake, that was lying with out-stretched neck, and fiery eyes, gazing steadily at the poor animal. The agony of the bird was so great that it was deprived of the power of moving away; and when one of the party killed the snake, it was found dead upon the spot—and that entirely from fear—for on examination it appeared not to have received the slightest wound.

The same gentleman informs us, that a short time afterwards he observed a small mouse, in similar agonizing convulsions, about two yards distant from a snake, whose eyes were intently fixed upon it; and on frightening away the reptile, and taking up the mouse, it expired in his hand.

The Hottentots who were with him said that this was very common; and the fact was confirmed by the assertions of all to whom he mentioned these instances†.

Dr. Barton of Philadelphia, however, after having examined with some care into the subject, is of opinion that the report of this fascinating property has had its rise in nothing more than the fears and cries of birds and other animals in the protection of their nests and young. He says that "the result of not a little attention has taught him, that there is but one wonder in the business;——the wonder that the story should ever have been believed by any man of understanding and observation*." But the above facts, if they are such, and till they are proved otherwise we must esteem them such, apply so ill to Dr. Barton's conclusion, as to induce a supposition that his opinion is not so well founded as it might appear to be from the perusal of his paper only, and without comparing it with other accounts.

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* Penn. Arct. Zool. ii. 338.

† Vaillant's New Travels, i. 33—37.

In summer the Rattle-snakes are generally found in pairs: in winter they collect in multitudes, and retire into the ground, beyond the reach of the frost. Tempted by the warmth of a spring day, they are often observed to creep out in a weak and languid state. Mr. Pennant mentions that a person has seen a piece of ground covered with them, and that he killed with a rod between sixty and seventy; till overpowered with the stench he was obliged to retire †.

The American Indians often regale on the Rattle-snake.—When they find them asleep they put a small forked stick over their necks, which they keep immovably fixed to the ground, giving the snake a piece of leather to bite; and this they pull back several times with great force until they observe that their two poisonous fangs are torn out. They then cut off the head, skin the body, and cook it as we do eels; and their flesh is said to be extremely white and good*.

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* Amer. Phil. Tran. iv. 74—114. † Penn. Arct. Zool.

THE BOA TRIBE.

SOME of the animals of the present tribe grow to an enormous size. Three of the species are found in Asia, and the rest are confined to the warmer parts of America. None of them possess poisonous fangs.

They have scuta, or undivided plates, both on the abdomen and beneath the tail; and have no rattle.

THE GREAT BOA†.

This is a most immense animal, the largest of all the Serpent tribe, being frequently from thirty to forty feet in length, and of a proportionate thickness. The ground colour of the body is yellowish-grey, on which is distributed, along the back, a series of large chain-like, reddish-brown, and sometimes perfectly red variegations, with other smaller and more irregular marks and spots. It is a native of Africa, India, the larger Indian islands, and South America, where it chiefly resides in most retired situations in woods and marshy retreats*.

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* Hector St. John.—Brickell, 145.

† SYNONYMS.—Boa Constrictor. *Linn.*—Le Devin. *La Cepede.* —Constrictor Boa. *Shaw.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 92, 93.

A gentleman who had some large concerns in America assures us of the enormous length of these animals, and informs that he one day sent out a soldier with an Indian to kill some wild fowl, and in pursuing their game, the Indian, who generally went before, beginning to tire, sat down upon what he supposed to be the fallen trunk of a tree. But the monster beginning to move, the poor fellow perceived what it was that he had thus approached, and dropped down in an agony. The soldier, who at some distance saw what had happened, levelled his piece at the serpent's head, and by a lucky aim shot it dead; and, going up to the relief of his companion, found that he was also dead from his fright. On his return he related what had happened: the animal was ordered to be brought, and it was found to be thirty-six feet long. The skin was stuffed, and sent to the cabinet of the Prince of Orange.

In the island of Java we are assured that one of these monsters has been known to kill and devour a buffalo. In a letter printed in the German Ephemerides we have an account of a combat between an enormous serpent and a buffalo, by a person who assures us that he was himself a spectator. The serpent had for some time been waiting near the brink of a pool, in expectation of its prey;

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* Shaw's Gen. Zool. vol. iii.

when a buffalo was the first animal that appeared. Having darted upon the affrighted beast, it instantly began to wrap him round with its voluminous twistings; and at every twist the bones of the buffalo were heard to crack almost as loud as the report of a cannon. It was in vain that the animal struggled and bellowed; its enormous enemy entwined it so closely, that at length all its bones were crushed to pieces, like those of a malefactor on the wheel, and the whole body reduced to one uniform mass: the serpent then untwined its folds to swallow its prey at leisure. To prepare for this, and also to make it slip down the throat the more smoothly, it was seen to lick the whole body over, and thus cover it with a mucous substance. It then began to swallow it at the end that afforded the least resistance; and in the act the throat suffered so great a dilatation that it took in at once substance that was thrice its own thickness.

According to the Bombay Courier of August 31, 1799, a Malay prow was making for the port of Amboyna, but, the pilot finding she could not enter it before dark, brought her to anchor for the night close under the island of Celebes. One of the crew went on shore in quest of betel-nut in the woods, and on his return lay down, as it is supposed, to sleep on the beach. In the course of the night he was heard by his comrades to scream out for assistance. They immediately went on shore: but it was too late; for an immense snake of this species had crushed him to death. The attention of the monster being entirely occupied by his prey, the people went boldly up to it, cut off its head, and took both it and the body of the man on board their boat. The snake had seized the poor fellow by the right wrist, where the marks of the fangs were very distinct; and the mangled corpse bore evident signs of being crushed by the monster's twisting itself round the head, neck, breast, and thigh. The length of the snake was about thirty feet, its thickness equal to that of a moderate-sized man; and on extending its jaws they were found wide enough to admit at once a body the size of a man's head.

We have been assured by travellers that these animals are sometimes found with the body of a stag in their gullet; while the horns, which they are unable to swallow, are seen sticking out at their mouths.

It is happy for mankind that their rapacity is often their own punishment; for, whenever they have gorged themselves in this manner, they become torpid, and may be approached and destroyed with safety. Patient of hunger to a surprising degree, whenever they seize and swallow their prey, they seem, like surfeited gluttons, unwieldy, stupid, helpless, and sleepy. They at that time seek for some retreat, where they may lurk for several days together, and digest their meal in safety. The smallest effort then will destroy them; they scarcely can make any resistance; and equally unqualified for flight or opposition, even the naked Indians do not fear to assail them. But it is otherwise when this sleeping interval of digestion is over; they then issue, with famished appetites, from their retreats, and with accumulated terrors, while every animal of the forest flies from their presence.

When captain Stedman was on board one of his boats on the river Cottica in Surinam, he was informed by one of his slaves that a large snake was lying among the brush-wood on the beach, not far distant; and after some persuasion he was induced to land in order to shoot it. On the first shot the ball, missing the head, went through the body; when the animal struck round, and with such astonishing force as to cut away all the underwood around him with the facility of a scythe mowing grass; and by flouncing his tail caused the mud and dirt, in which he lay, to fly over the men's heads that were with him, to a considerable distance. They started back some way, but the snake was quiet again in a few minutes. Captain Stedman again fired, but with no better success than before; and the animal sent up such a cloud of dust and dirt as he had never seen but in a whirlwind; which caused them once more suddenly to retreat. After some persuasions he was induced, though much against his inclination, being exceedingly weak from illness, to make a third attempt. Having therefore once more discovered the snake, they discharged their pieces at once, and shot him through the head. The negro brought a boat-rope to drag him to the canoe which was lying on the bank of the river. This proved no easy undertaking, since the huge creature, notwithstanding his being mortally wounded, still continued to writhe and twist about in such a manner as to render it dangerous for any person to approach him.

The negro made a running noose on the rope, and, after some fruitless attempts to make an approach, threw it over his head with much dexterity; and now, all taking hold of the rope, they dragged him to the beach, and tied him to the stern of the canoe to take him in tow. Being however still alive, he here kept swimming like an eel.

The length of this animal, which the negroes declared to be only a young one, and but arrived at half its growth, was upwards of twenty-two feet; and its thickness about that of a boy near twelve years old, as was proved by measuring the creature's skin round the body of the boy that was with them.

When they came to one of their stations they hauled him on shore, to skin him, and take out the oil, &c. To effect this purpose, one of the negroes, having climbed up a tree with the end of a rope, let it down over a strong forked branch, and the others hoisted up the snake and suspended him from the tree. This done, the former negro, with a sharp knife between his teeth, left the branch, and clung fast upon the monster, which was still writhing, and began his operations by ripping it up, and stripping down the skin as he descended. "Though I perceived (says the captain) that "the animal was no longer able to do him any in-"jury, I confess I could not without emotion see "a man stark naked, black and bloody, clinging "with his arms and legs round the slimy and yet "living monster." This labour, however, was not without its use; since he not only dexterously finished the operation, but saved from the animal above four gallons of fine clarified fat, or rather oil, which proved of much use to the surgeons at the hospital. As much again as this was also supposed to have been wasted. The negroes cut the animal in pieces, and would have eaten it, had they not been refused the use of the kettle to boil it in.—The bite of this snake is said not to be venomous; nor is it believed to bite at all from any other impulse than that of hunger*.

THE SNAKE TRIBE.

THIS genus contains a great number of species, (near *two hundred,*) which differ from each other very greatly both in size and habit. About one fifth of the whole have been discovered to be poisonous: these are in general to be distinguished from the rest by their large, flattish, and somewhat heart-shaped heads, and rather short than long bodies and tails. The harmless species have, for the most part, small heads, with more extended bodies.

All the species have scuta or undivided plates under the abdomen; and broad alternate squamæ or scales beneath the tail.

In the investigation of this genus it is to be remarked that the subcaudal scales, although alternate, are reckoned by pairs; so that the number marked by Linnæus for the respective species always means the number of pairs[*].

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* Stedman's Account of Surinam.

THE COMMON VIPER[†].

Vipers are pretty generally dispersed over the old Continent, and are by no means uncommon in our own island, particularly in the dry, stony and chalky counties.

They do not often exceed the length of two feet, though they are sometimes found above three. The ground colour of their bodies is a dirty yellow, deeper in the female than in the male. The back is marked throughout with a series of rhomboidal black spots joining each other at the points; and the sides have triangular ones. The belly is entirely black[‡].—They are chiefly distinguished from the Common Snake by their darker belly, their head much thicker than the body, and in particular by the tail, which, though it ends in a point, does not run tapering to so great a length as in the Snake. When therefore other distinctions fail, the difference of the tail may be distinguished at a single glance.

The apparatus of poison in the Viper is very similar to that of the Rattle-Snake, and all the other poisonous serpents. The symptoms that follow the bite are an acute pain in the wounded part, with a swelling, at first red, but afterwards livid, which by degrees spreads to the adjoining parts; with great faintness, and a quick, though low, and sometimes interrupted pulse; great sickness at the stomach, with bilious, convulsive vomitings, cold sweats, and sometimes pain about the navel. The most esteemed remedy is common sallad-oil thoroughly rubbed on the wounded part. This is always used by the viper-catchers, and seems far more efficacious than any volatile alkali, as formerly recommended. The bite of the Viper in this country, although it produces a painful and troublesome swelling, is rarely attended with any other bad consequence.

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[*] Shaw's Gen. Zool. vol. iii.

[†] Synonyms.—Coluber berus. *Linn.*—Viper. *Penn.*—English Viper, Adder. *Ray.*—*Shaw's Gen. Zool. vol.* 3. *tab.* 101.—*Penn. Brit. Zool. vol.* 3. *tab.* 4.

[‡] Penn. Brit. Zool. i, 27.

The poison, according to Dr. Mead, when diluted with a little warm water and applied to the tip of the tongue, is very sharp and fiery, a sensation taking place as if the tongue had been struck through with something scalding or burning. This, he says, goes off in two or three hours. One person, mentioned by Dr. Mead, tried a large drop of it undiluted; in consequence of which his tongue swelled, with a little inflammation, and the soreness lasted two days. Other persons, on the contrary, assert it to have no particular acrimony of taste, but that in this respect it rather resembles oil or gum. Contradictions nearly equal have taken place, relative to the effect of viperine poison taken into the stomach. Boerhaave affirms it to produce no ill effect whatever; and the abbé Fontana, that it is not to be swallowed with impunity—although he is one of those who assert its being devoid of any thing unpleasant to the taste. We are however told, that in the presence of the Grand Duke of Tuscany, while the philosophers were making elaborate dissertations on the danger of the poison taken inwardly, a viper-catcher, who happened to be present, requested that a quantity of it might be put into a vessel, and then with the utmost confidence, and to the astonishment of the whole company, he drank it off in their presence. Every one expected the man instantly to drop down dead; but they soon perceived their mistake, says the relater of the story, and found that taken in this manner the poison was as harmless as water.

In ancient times the poison of the Viper was collected by many of the European nations as a poison for their arrows, as that of other serpents is used, by the inhabitants of savage nations, at the present day.

The Viper is the only one either of the Reptile or Serpent tribes, in Great Britain, from whose bite we have any thing to fear. All the others are either entirely destitute of poison; or, if they possess any, it is not injurious to man.

These animals are viviparous, and produce their young towards the close of summer. The eggs, which are hatched in the womb, are usually ten or twelve only in number, and chained together somewhat like a string of beads. When the young have burst the shell, they are said to creep by their own efforts from their confinement into the open air, where they continue for several days without taking any food. The Rev. Mr. White of Selborne, in company with a friend, surprised a large female viper, which seemed very heavy and bloated, as she lay on the grass, basking in the sun. They killed and cut her up, and found in the abdomen fifteen young ones about the size of full-grown earth-worms. This little fry issued into the world with the true viper spirit about them, showing great alertness as soon as disengaged from the belly of the dam. They twisted and wriggled about, set themselves up, and gaped very wide when touched with a stick; showing manifest tokens of menace and defiance, though as yet no fangs were to be discovered even with the help of glasses *.

That the young, for some time after their birth, retreat, when suddenly alarmed, into the mouth of the female, in the same manner as the young of the Opossum do into the abdominal pouch of their parent, seems to be a fact satisfactorily ascertained. —Vipers arrive at their full growth in about seven years, and produce at the end of their second or third.—Their food consists of reptiles, worms or young birds, which they swallow whole, though it sometimes happens that the morsel is thrice the thickness of their own body.

They are capable of supporting long abstinence, one of them having been kept above six months in a box without food; during which time its vivacity was not lessened.—When at liberty they remain torpid throughout the winter; yet, when confined, they have never been observed to take their annual repose.

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* White's Natural History of Selborne.

They are usually caught with wooden tongs by the end of the tail. This is done without danger; for, while they are held in that position, they cannot wind themselves up to injure their enemy.

Their flesh was formerly in high esteem as a remedy for various diseases, but particularly as a restorative. It has, however, of late years lost much of its ancient credit, and is very rarely prescribed by modern practitioners.

THE COMMON SNAKE*.

The Common or Ringed Snakes are well-known inhabitants of moist and warm woods, on the dry banks of which they are often seen during the summer, either sleeping or basking themselves. They are harmless and inoffensive animals, being totally destitute of every means of injuring mankind.

They deposit their eggs in warm and moist situations, as under hedges or in dunghills, in the form of a continued chain of ova, to the number of from twelve to twenty. These are about the size of the eggs of the blackbird, of a whitish colour, and covered with a parchment-like membrane. They are not hatched till the spring following the time when they are laid †.

In winter these Snakes conceal themselves, and become nearly torpid; re-appearing in spring, when they uniformly cast their skins. This is a process that they also seem to undergo in the autumn. Mr. White says, " About the middle of this month (September) we found in a field near a hedge the slough of a large snake, which seemed to have been newly cast. From circumstances it appeared as if turned wrong side outward, and as if drawn off backward like a stocking or woman's glove. Not only the whole skin, but the scales, from the very eyes, were peeled off, and appeared in the head of the slough like a pair of spectacles. The reptile, at the time of changing his coat, had entangled himself intricately in the grass and weeds, so that the friction of the stalks and blades might promote this curious shifting of his exuviæ.

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* SYNONYMS.—Coluber natrix. *Linn.*—Ringed Snake. *Penn.* ——*Penn. Brit. Zool. vol.* 3. *tab.* 4.

† Shaw's Gen. Zool. iii.

> ———————— ' Lubrica serpens
> ' Exuit in spinis vestem.' *Lucret.*

" It would be a most entertaining sight could a person be an eye-witness to such a feat, and see the snake in the act of changing his garment. As the convexity of the eyes in the slough is now inward, that circumstance alone is a proof that the skin has been turned; not to mention that now the present inside is much darker than the outer. If you look through the scales of the snake's eyes from the concave side, viz. as the reptile used them, they lessen objects much.—Thus it appears from what has been said, that snakes crawl out of the mouth of their own sloughs, and quit the tail part last, just as eels are skinned by a cook-maid.—While the scales of the eyes are growing loose, and a new skin is forming, the creature, in appearance, must be blind, and feel itself in a very awkward and uneasy situation*."

The earliest time of the snakes' making their appearance is in the month of March, from which period till the middle of May they are to be found in vast numbers on warm banks in moist and shady places. From this time, probably on account of the great heat of summer, they are not so often seen.

Several instances have occurred of the Common Snake being in a great degree domesticated. Mr. White says that he knew a gentleman who had one in his house quite tame. Though this was usually as sweet in its person as any other animal, yet whenever a stranger, or a dog or cat entered, it would begin to hiss, and soon filled the room with an effluvia so nauseous as to render it almost insupportable†.

An intimate friend of the editor ‡ had a Common Snake in his rooms at Cambridge near three months. He kept it in a box of bran; and during all that time he never could discover that it ate any thing, although he frequently put both eggs and frogs, the favorite food of this species, into the box. Whenever he was in the room he used to let the animal out of its prison: it would first crawl several times round the floor, apparently with a desire to escape; and when it found its attempts fruitless, it would climb up the tables and chairs, and not unfrequently even up the chair of its owner as he sate at his table: At length it became so familiar as to lie in a serpentine form on the top bar of his chair: it would crawl through his fingers if held at a little distance before its head, or lie at full length upon his table while he was writing or reading, for an hour or more at a time. When first brought into the room it used to hiss and dart out its forked tongue; but it in no one instance emitted any unpleasant vapour. It was in all its actions remarkably cleanly. Sometimes it was indulged with a run upon the grass in the court of the college, and sometimes with a swim in a large bason of water, which it seemed to enjoy very much. When this gentleman left the University he gave his bedmaker orders to turn it out into the fields; which he believes was done.

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* White's Naturalist's Calendar. † White's Natural History of Selborne. ‡ Mr. Revett Sheppard, F. L. S. of Gonvil and Caius College, Cambridge.

These animals prey on frogs, insects, worms and mice, for the former of which they often go into the water, where they swim with great elegance. After a snake has devoured a tolerably large frog, or a small bird, its prey will be seen to form a knot in its body, and it then becomes so stupid and inactive as easily to be caught.—The gentleman who favoured the editor with the preceding account of a tame snake, was witness to one of these animals seizing a frog. It laid hold of it by surprise, by one of the legs, and immediately began to swallow it. He watched them for near a quarter of an hour; when the poor frog cried out so piteously that he determined to release it; but in the struggle the leg and thigh had been torn off and devoured.

It is supposed to be of a species nearly allied to this, called the *French Snake*, that an interesting anecdote is related by Bomare. He says that one of these had been so completely tamed by a lady, as to come to her whenever she called it, to follow her in her walks, writhe itself round her arms, and sleep in her bosom. One day, when she went in a boat to some distance up a large river, she threw the snake into the water, imagining that its fidelity would lead it to follow her, and that by swimming it would readily overtake the boat. The poor animal exerted all its efforts; but the current proving at that juncture unusually strong, owing to the advance of the tide, in spite of all its struggling to effect its purpose, it was borne down the stream, and was unfortunately drowned*.

THE HOODED SNAKE†.

This dreadful serpent is very common in many parts of India. Its general length is three or four feet, and thickness somewhat more than an inch. The head is rather small; and a little beyond it is a lateral dilatation of the skin, which is continued to the length of about four inches downwards, where it gradually sinks into the cylindrical form of the rest of the body.

This part is extended at pleasure: it is usually marked on the top by a very large and conspicuous patch resembling a pair of spectacles. The usual colour of the Hooded Snake is a pale rusty brown above, and beneath a blueish white tinged with yellow. The tail tapers to a slender and sharply pointed extremity.

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* Dictionnaire Raisonné Universel d'Histoire Naturelle.

† SYNONYMS.—Coluber Naja. *Linn.*—Cobra di Capello. *Var.*—Spectacle Snake. *Shaw.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 107.

When it is irritated or preparing to bite, this animal raises up the fore part of its body, bends down its head, and seems, as it were, hooded by the expanded skin of the neck: hence its name of Cobra di Capello or Hooded Serpent *.

From its frequently moving along with great part of its body erect, and with its head in continual action, as if looking around with great circumspection, this species is in India esteemed the emblem of prudence. It is also an object of superstitious veneration among the Gentoo Indians, founded on some traits of legendary mythology: they seldom name it without adding some epithet, such as the royal, the good, the holy. Some of them are happy when they see it running about their houses; from whence many have received irreparable injuries; for it is very possible to hurt it unintentionally, either without seeing it, or during sleep, and it immediately revenges itself with fury. Its bite is sometimes mortal in two or three hours, especially if the poison has penetrated the larger vessels, or muscles.—A dog bitten by one of them died in twenty-seven minutes; and another, larger, survived fifty-six minutes. A chicken died in less than half a minute, though others survived a couple of hours, depending probably on the heat of the weather and the condition of the serpent at the time.

In India the Hooded Snake is carried about in a basket to be publicly exhibited as a show, being first

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* Shaw's Gen. Zool. iii.

deprived of its fangs to secure the men from the danger of its bite. At the sound of a flageolet it is taught to assume a kind of dancing attitude and motions, which it continues so long as its master continues his music.

THE WATER VIPER *.

This is a large species, called in Carolina and some other parts of America the Water Rattle-Snake. Its tail however, instead of a rattle, ends in a somewhat blunt horny point about half an inch in length. The head and back are brown, and the belly is marked transversely with alternate black and yellow marks. The neck is small, and the head large, and armed with weapons as destructive as those of the Banded Rattle-Snake. It is a very active creature, and particularly dexterous in catching fish.

In the summer great numbers of them may frequently be seen lying on the branches of trees that hang over rivers, from which at the approach of a boat they drop into the water, or sometimes even into the boat. They in these situations are able to surprise both birds and fish. To take the latter they plunge into the water, and pursue them with astonishing swiftness. Some that they seize and bring ashore with them are of a very large size. Mr. Catesby saw a Water Viper swimming to shore with a large species of Catfish, that had two long bones sticking out of each side of the gills, which were so fixed in the jaws of the snake, that with all his writhes and intortions he was not able to disengage himself.

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* Coluber aquaticus. *Shaw.*—Water Viper. *Catesby.*——*Shaw's Gen. Zool. vol.* 3. *tab.* 111.

In this condition being in danger of drowning he immediately came to land, where he was killed.

The American Indians hold this species in the utmost dread on account of his horny tail; and, although this part is perfectly harmless, they believe that the animal is armed with death at both ends. With this fatal horn they say he is not only able to wound and kill both men and other animals, but, ridiculously enough, that if he strikes with it the bark of a young tree, it will instantly wither, turn black and die *.

THE BLACK SNAKE †.

The Black Snake is a North American serpent, that grows to a great length, but possesses no poisonous qualities. It is very smooth and slender, black on the upper parts, and of a pale blue beneath, except the throat, which is white.

Its activity is astonishing; and in speed it will sometimes equal a horse. The different motions of these creatures are very diverting: they will at times climb the trees in quest of the Tree Frogs; or, for other prey, glide at full length along the ground. On some occasions they present themselves half erect, and in this posture their eyes and their heads appear to great advantage. The former display a fiery brightness, by means of which we are told they are able to fascinate birds, and the smaller quadrupeds, in a manner similar to the Rattle-Snake. Its body is said to be so brittle that if, when pursued, it gets its head into a

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* Catesby, ii. 43.

† *Coluber* Constrictor. *Linn.*

hole, and a person seizes hold of its tail, it will sometimes twist itself to pieces*.

The Black Snake is sometimes bold enough to attack a man, and not to depart before it has received a smart stroke from a stick, or whatever other weapon he may chance to have in his hand. When it overtakes a person who has endeavoured to escape (not having had courage enough to oppose it), it is said to wind itself round his legs in such a manner as to throw him down, and then to bite him several times in the leg, or wherever it can lay hold of, and run off again.

During professor Kalm's residence at New York, Doctor Colden told him, that in the spring of 1748, he had several workmen at his country-seat, and among them one just arrived from Europe, who, of course, knew but little of the qualities of the Black Snake. The other workmen, who observed a male and female lying together, engaged their new companion to kill one of them. He accordingly approached them with a stick in his hand: this the male observed, and made towards him. The man little expected to find such courage in the reptile, and, flinging away his stick, ran off as fast as he was able. The snake pursued, overtook him, and twisting several times round his legs threw him down, and almost frightened the poor fellow out of his senses. He could not rid himself of the snake without cutting it through in two or three places with a knife. The other workmen laughed heartily at the incident without ever offering to help their companion, looking upon the whole affair only as a scene of the highest amusement.

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* Brickell, 153.

This snake, which is harmless except in the spring, is very greedy of milk, and it is difficult to keep it out when once it is accustomed to get into a cellar where milk is kept. It has been seen eating milk out of the same dish with children without biting them, though they often gave it blows with their spoons upon the head, when it was too greedy.

It is said to be found extremely useful in America in clearing houses of rats, which it pursues with wonderful agility even to the very roofs of barns and out-houses; for which good services it is cherished by the generality of the Americans. It is also said that it will destroy the rattlesnake by twisting round it, whipping it to death, and then swallowing it. It is so swift that there is no escaping its pursuit, but its bite has no more effect than a scratch with a pin. All the mischief this species does is to the farmers' wives; for it will skim the milk-pans of the cream, and rob the hen-roosts of all the eggs. It is not very uncommon to find it coiled up in a nest under the sitting hen*.

The following description of a contest between the Black Snake, and another species, is extracted from the Letters of an American Farmer: "One of my constant walks when I am at leisure (says this gentleman) is in my lowlands, where I have the pleasure of seeing my cattle, horses, and colts. Exuberant grass replenishes all my fields, the best representative of our wealth: in the middle of that tract, I have cut a ditch eight feet wide: on each side of this I carefully sow every year some grains of hemp, which rise to the height of fifteen feet, so strong and full of limbs, as to resemble young trees: I once ascended one of them four feet above the ground. These produce natural arbours, rendered often still more compact by the assistance of an annual creeping plant, which we call a vine, that never fails to entwine itself among the branches, and always produces a very desirable shade. As I was one day sitting, solitary and pensive, in this primitive arbour, my attention was engaged by a strange sort of rustling noise, at some paces distance. I looked all around without distinguishing any thing, until I climbed up one of my great hemp-stalks; when, to my astonishment, I beheld two snakes of considerable length, the one pursuing the other with great celerity through a hemp stubble field. The aggressor was of the black kind, six feet long; the fugitive was a water snake, nearly of equal dimensions. They soon met, and, in the fury of their first encounter, appeared in an instant firmly twisted together; and whilst their united tails beat the ground, they mutually tried with open jaws to lacerate each other. What a fell aspect did they present! Their heads were compressed to a very small size, their eyes flashed fire; and after this conflict had lasted about five minutes, the second found means to disengage itself from the first, and hurried toward the ditch. Its antagonist instantly assumed a new posture, and half creeping, half erect, with a majestic mien, overtook and attacked the other again, which placed itself in a similar attitude, and prepared to resist.

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* Catesby, ii. 48. Brickell, 153. Penn. Arct. Zool. ii. 342.

The scene was uncommon, and beautiful, for thus opposed they fought with their jaws, biting each other with the utmost rage; but notwithstanding this appearance of mutual courage and fury, the water snake still seemed desirous of retreating towards the ditch, its natural element. This was no sooner perceived by the keen-eyed black one, than, twisting its tail twice round a stalk of hemp, and seizing its adversary by the throat, not by means of its jaws, but by twisting its own neck twice round that of the water snake, he pulled it back from the ditch. To prevent a defeat, the latter took hold likewise of a stalk on the bank, and, by the acquisition of that point of resistance, became a match for his fierce antagonist. Strange was this to behold: two great snakes strongly adhering to the ground, mutually fastened together by means of the writhings which lashed them to each other, and stretched at their full length, they pulled, but pulled in vain; and in the moments of greatest exertion that part of their bodies which was entwined, seemed extremely small, while the rest appeared inflated, and now and then convulsed with strong undulations rapidly following each other. Their eyes appeared on fire, and ready to start out of their heads. At one time the conflict seemed decided; the water-snake bent itself into great folds, and by that operation rendered the other more than commonly outstretched; the next minute the new struggles of the black one gained an unexpected superiority, it acquired two great folds likewise, which necessarily extended the body of its adversary in proportion as it had contracted its own. These efforts were alternate, victory seemed doubtful, inclining sometimes to one side, sometimes to the other; until at last the stalk to which the black snake was fastened, suddenly gave way, and, in consequence of this accident, they both plunged into the ditch. The water did not extinguish their vindictive rage, for by their agitations I could still trace, though I could not distinguish, their attacks. They soon re-appeared on the surface, twisted together, as in their first onset: but the black snake seemed to retain its wonted superiority; for its head was exactly fixed above that of the other, which it incessantly pressed down under the water, until it was stifled, and sunk. The victor no sooner perceived its enemy incapable of further resistance, than, abandoning it to the current, it returned to the shore and disappeared*."

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* Hector St. John, 244.

FISHES.

> "There are yet hid greater things than these be, for we have "seen but few of the Lord's works."
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> ECCLESIASTICUS, ch. xliii. ver. 32.

WERE we acquainted with no other animals than those that inhabit the land, and breathe the air of our atmosphere, it would appear absurd to be told that any race of beings could exist only in the waters; we should naturally conclude from the effect produced on our own bodies, when plunged into that element, that the powers of life could not there be sustained. But we find from experience that the very depths of the ocean are crowded with inhabitants, that in their construction, modes of life, and general design, are as truly wonderful as those of the land, and afford additional proofs, to those of the other classes of animals, of the infinite wisdom of our sovereign Creator.

As considerable velocity is necessary to the animals composing the present class, their bodies are in general slender and thin, flattened at the sides, and always somewhat pointed at the head, to cut their way through the resisting medium which they inhabit. They are in general covered with a kind of horny scales, to keep their bodies from being injured by the pressure of the water. Several are enveloped with a fat and oily substance, to preserve them from putrefaction, and to guard them from extreme cold.

They *breathe* by means of those comb-like organs placed on each side of the neck, called gills. In doing this they fill their mouth with water, then drive it backwards with so much force as to lift open the great flap, and force it out behind. And in the passage of this, among the feather-like processes of the gills, all, or at least the greatest part, of the air contained in it, is left behind, and carried into the body to perform its part in the animal economy. In proof of this fact, it has been ascertained, that if the air has by any means been taken out of the water, into which fish are put, they immediately come to the surface and gasp for air.—Distilled water is to fish what the vacuum formed by an air-pump is to most other animals.—This is the reason why in winter, when a fish-pond is entirely frozen over, it is necessary to break holes in the ice, not that the fish may come to feed, but that they may come to breathe. Without this precaution, if the pond is small and they are numerous, they will die from the corruption of the water.

Fishes are nearly of the same specific gravity with water, and *swim* by means of their fins and tail. The muscular force of the latter is very great. Their direct motion is obtained by moving the tail from one side to the other, with a vibrating motion. When about to move itself, the fish turns the end obliquely to the water, and moves it through it in that position. The water re-acts obliquely against the tail, and moves him partly forward, and partly laterally. The lateral motion is corrected by the next stroke the contrary way, while the progressive motion is continued. Assisted by their tail, they turn sideways: striking strongly with it on that side, and keeping it bent, it acts like the rudder of a ship. The fins of a fish keep it upright, especially the belly fins, which act like two feet: without these he would swim with his belly upwards, as the centre of gravity lies near the back. By contracting or expanding the fins, they also assist him in ascending and descending: by inclining his tail obliquely, and turning it a little from an erect position to one side, it helps him to rise and fall. Fishes in general swim but slowly, and soon tire; some of them, however, are said to swim seventy or eighty yards in a minute.

In addition to the fins and tail the *air-bladder* is of material assistance to them in swimming, as it is by this that they increase or diminish the specific gravity of their bodies. When they press the air contained in it, by means of their abdominal muscles, the bulk of their body is diminished, their weight, compared with that of the water, is increased, and they consequently sink. If they want to rise, they relax the pressure of the muscles, the air-bladder again acquires its natural size, the body is rendered more bulky, and they again rise. This bladder lies in the abdomen, along the course of the back-bone. The air appears to be conveyed into it from the blood, by means of vessels appropriated to the purpose, and it can be discharged into the stomach or the mouth. The Turbot, Sole, and other flat fish, which have no air-bladder, are in consequence entirely confined to the bottom of the water: and when the bladders of any fish are burst, they are never afterwards able to rise. —From a knowledge of this fact, the fishermen, after taking a quantity of Cod-fish, are able to keep them alive for a considerable time in their well-boats. They perforate the sound or air-bladder with a needle, disengage the enclosed air, and then throw them into the well, where they immediately sink to the bottom. Without this operation, they would not be able to keep them under water.

The *teeth* of fishes are usually situated in their jaws: sometimes, however, they are found on the tongue or palate, and even in the throat. They are in general sharp-pointed and immoveable; but in the Carp they are obtuse, and in the Pike so moveable as to appear fixed only to the skin.—The *tongue* is in general motionless, obtuse and fleshy, and in the Herring, and some other species, this is set with teeth, to enable them the better to retain their food.—Being furnished with nostrils and olfactory nerves, there can be little doubt of fishes possessing the sense of smelling.

The *bones* are formed of a kind of intermediate substance, between true bones and cartilages. The back-bone extends the whole length of the body, and consists of vertebræ, strong and thick towards the head, but weaker and more slender as it approaches the tail. Each species has a determinate number of vertebræ, which increase in size with the body. The ribs are attached to the processes of the vertebræ, and inclose the breast and abdomen. Between the pointed processes of the vertebræ lie the bones, that support the anal and dorsal fins, which are connected with the processes by a ligament. At the breast lie the sternum, the clavicles, and the scapulæ, on which the pectoral fins are placed; the bones that support the ventral fins are called the ossa pelvis. Besides these there are often other small bones between the muscles to assist their motion.

Fishes are for the most part oviparous, committing their immensely numerous ova to the influences of the water and sun to be hatched, generally near the shore, that the genial heat may the more easily reach them. Some species that inhabit the ocean, attach their ova to the sea-weeds.—The eggs are mostly spherical, and are altogether without shells. A few fishes, as the Eel, as pecies of Blenny, and some others, are viviparous.

It is very probable that they live to a considerable age. They grow quickly, and continue to increase in size as long as they live. From the concentric circles on their scales, it is supposed that their age may be determined.

As to their general economy, and their habits, from their deep retirement in an element forbidden to the approaches of mankind, it cannot be supposed that much knowledge has been acquired: and naturalists will ever have to lament their extreme want of ability to search into the characters of these animals, which would otherwise prove so very deserving of their notice.

In the Gmelinian edition of the Systema Naturæ the Fishes are divided into six orders: Apodal, Jugular, Thoracic, Abdominal, Branchiostegous, and Chondropterygious *.

1. *Apodal*; with bony gills, and no ventral fins.

2. *Jugular*; with bony gills, and ventral fins before the pectoral.

3. *Thoracic*; with bony gills, and ventral fins placed directly under the thorax.

4. *Abdominal*; with bony gills, and ventral fins placed on the belly behind the thorax.

5. *Branchiostegous*; with gills destitute of bony rays.

6. *Chrondropterygious*; with cartilaginous gills.

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* Apodes, Jugulares, Thoracici, Abdominales, Branchiostegi, and Chondropterygii.

FISHES.

APODAL FISH.

THE Apodal Fish, in their appearance and manners, approach in some instances very nearly to the Serpent tribes. They have a smooth and slippery skin, in general naked, or covered only with small, soft, and distant scales. Their bodies are long and slender, and they are supposed to live entirely on animal substances.

THE EEL TRIBE.

IN this tribe the head is smooth, and the nostrils are tubular. The gill-membrane has ten rays. The eyes are covered with a common integument. The body is nearly cylindrical, smooth and slippery. The tail, the back, and the anal fins are united; and the spiracle is behind the head, or the pectoral fins.

There are about nine species, most of which are found only in the seas. One of these frequents our fresh waters, and three others occasionally visit our shores.

THE COMMON EEL*.

The Common Eel forms evidently a connecting link, in the chain of nature, between the Serpent tribe and the Fishes, possessing not only, in a great measure, the serpent form, but also many of their habits.

It is frequently known to quit its element, and to wander, in the evening or night, over meadows in search of snails and other prey, or to other ponds for change of habitation. This will account for eels being found in waters that have not been in the least suspected to contain them. An instance of this rambling spirit of the eels is mentioned in Plott's Natural History of Staffordshire.

Mr. Arderon, in the Philosophical Transactions, says, that in June 1746, while he was viewing the flood-gates belonging to the water-works of Norwich, he observed a great number of eels sliding up them, and up the adjacent posts, to the height of five or six feet above the surface of the water. They ascended with the utmost facility, though many of the posts were perfectly dry and quite smooth. They first thrust their heads and about half their bodies out of the water, and held them against the wood-work for some time; Mr. A. imagines while they found the viscidity of their bodies sufficiently thick, by exposure to the air, to support their weight. They then began to ascend directly upwards, and with as much apparent ease as if they had been sliding on level ground: this they continued till they had got into the dam above*.

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* Muræna Anguilla. *Linn.*

Of the migration of young eels from one part of a river to another, a singular instance is stated by Dr. Anderson in his publication called the Bee. "Having occasion (says this gentleman) to be once on a visit at a friend's house on Dee-side, in Aberdeenshire, I often delighted to walk by the banks of the river. I one day observed something like a black string moving along the edge of the river in shoal water. Upon closer inspection I discovered that this was a shoal of young eels, so closely joined together as to appear, on a superficial view, one continued body moving briskly up against the stream. To avoid the retardment they experienced from the force of the current, they kept close along the water's edge the whole of the way, following all the bendings and sinuosities of the river. Where they were embayed, and in still water, the shoal dilated in breadth, so as to be sometimes near a foot broad; but when they turned a cape, where the current was strong, they were forced to occupy less space, and press close to the shore, struggling very hard till they passed it.

"This shoal continued to mo[illegible]n night and day, without interruption, for several weeks. Their progress might be at the rate of about a mile an hour. It was easy to catch the animals, though they were very active and nimble. They were eels perfectly formed in every respect, but not exceeding two inches in length. I conceive that the shoal did not contain, on an average, less than from twelve to twenty in breadth ; so that the number that passed on the whole, during their progress, must have been very great. Whence they came, or whither they went, I know not. The place I remarked them at was six miles from the sea, and I am told that the same phenomenon takes place there every year about the same season*."

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* Arderon on the Perpendicular Ascent of Eels, in Phil. Tran. vol. xliv. p. 395.

The usual haunts of eels are in mud, among weeds, under the roots or stumps of trees, or in holes in the banks or the bottom of rivers. They are partial to still water, and particularly to such as is muddy at the bottom. Here they often grow to an enormous size, sometimes weighing fifteen or sixteen pounds. —One that was caught near Peterborough, in the year 1667, measured a yard and three quarters in length†. When kept in ponds they have been known to destroy young ducks. Sir John Hawkins, from a canal near his house at Twickenham, missed many of the young ducks; and on draining, in order to clean it, great numbers of large eels were found in the mud. In the stomachs of many of them were found, undigested, the heads, and part of the bodies of the victims ‡.

They seldom come out of their hiding-places but in the night, during which time they are taken with lines that have several baited hooks.—In winter they bury themselves deep in the mud, and, like the Serpent tribe, remain in a state of torpidity; and they are so impatient of cold as eagerly to take shelter in a whisp of straw flung into a pond in severe weather. This has sometimes been practised as a mode of catching them*.

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* Anderson's Bee, xi. p. 10. † Walton, 185.

‡ Note to Walton, 181.

Eels are viviparous. They are so tenacious of life, that their parts will continue to move for a considerable time after they are skinned and cut into pieces.

THE GYMNOTUS TRIBE.

The head is furnished with lateral opercula; and there are two tentacula on the upper lip. The eyes are covered with the common integument. The gill-membrane has five rays. The body is compressed, and has a fin running along the under parts.

THE ELECTRICAL GYMNOTUS, OR EEL †.

This most singular fish is peculiar to Surinam, in South America, where it is found only in the rocky parts of rivers at a great distance from the sea.

On a transient view it bears a great resemblance both in shape and colour to our Common Eel. It is from three to four feet in length, and ten or twelve inches in circumference, in the thickest part of its body. The head is flat, and the mouth wide and destitute of teeth. A fin about two inches deep extends from the point of its tail to within six inches of the head; and, where it joins the body, this fin is almost an inch thick. Across the body are several annular divisions, or rather rugæ of the skin, by which the fish seems to partake of a vermicular nature, and to have the power of contracting or dilating itself at pleasure. It is able to swim backwards as well as forwards.'

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* Penn. Brit. Zool. iii. 143.

† Synonyms.—Gymnotus electricus. *Linn.*—Cold Eel. *Smith.* —Cramp-fish, Numbing Eel, by the English,—Beave Aal, by the Dutch.—Electric Eel. *Phil. Trans.*

These fishes possess the singular property of giving a shock, similar in its effects to that produced from a charged jar, to any body, or any number of bodies connected together. In different publications, domestic and foreign, we have numerous accounts of experiments on the Electric Eel: the principal of these however, are inserted in the Philosophical Transactions, by Dr. Williamson and Dr. Garden.

The former of these gentlemen says, that on touching an electrical Eel with one hand, a sensation is experienced similar to that arising from touching the conductor of an electrical machine: with a short iron rod the same was felt, but less powerfully. While another person provoked the fish, Dr. W. put his hand into the water, at the distance of three feet from it, and felt an unpleasant sensation in the joints of his fingers. Some small fish were thrown into the water, and the animal immediately stunned and swallowed them. A larger fish was thrown in, which he stunned likewise, and attempted to swallow; but, from its size, he could not do it. Dr. W. put his hand into the water, and had another fish thrown in at some distance. The Eel swam up to it, and at first turned away without offering it any violence: after a little time he returned, and, looking stedfastly at it a few seconds, gave it a shock, by which it instantly turned upon its back, and was perfectly motionless. Dr. W. at that very instant felt the same sensation in his fingers as when he put his hand into the water before. A fish was afterwards struck, but not quite killed: when the Electric Eel perceived this he returned, and at a second shock, evidently more severe than the former, rendered it motionless. On touching it with one hand so as to provoke it, and holding the other in the water at a little distance, a severe shock was felt through both the arms, and across the breast, similar to that from a charged jar. Eight or ten persons with their hands joined experienced the same, on the first touching the head, and the last the tail of the fish. A dog being made a link in this chain, at the instant of contact uttered a loud yell*. When the Eel was touched with silk, glass, or any other non-conductor, no shock whatever was felt. From a long series of experiments, it appeared to Dr. Williamson, that these properties partook so nearly of the nature of electricity, that whatever would convey the electrical fluid would also convey the fluid discharged by the Eel; and vice versa. He, however, was never able to observe that any spark whatever was produced on contact. This mode of defence the fish never adopted except it was irristunned by the shock as to appear dead, but when these have been taken into another vessel they have been always found to recover.—When the Electrical Eels are hungry they are pretty keen after their food; but they are soon satisfied, not being able to contain much at one time. One of them three feet and upwards in length could not swallow a small fish above three, or at most three inches and a half long.

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* Vaillant's New Travels, i, 80.

The organs that produce this wonderful accumulation of electric matter constitute nearly one half of that part of the flesh in which they are placed, and, perhaps, compose more than one third of the whole animal. There are two pairs of these organs, one on each side. Their structure is very simple and regular, consisting only of flat partitions, with cross divisions between them. The partitions are thin membranes placed nearly parallel to one another, and of different lengths and breadths. Their distances from each other differ with the size of the fish: in one of two feet four inches in length they were found to be $\frac{1}{29}$th of an inch asunder. They appear to answer the same purpose with the columns of the Torpedo, making walls or butments for the subdivisions, and are to be considered as forming so many distinct organs; they are very tender, and easily lacerated. These are furnished with many pairs of nerves appropriated to their management*; but how these surprising effects are produced by means of such organs, in a fluid also extremely ill-adapted to the purpose, has not yet been satisfactorily explained.

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* Hunter in Phil. Tran. vol. lxv. p. 395.

It has been said that specimens of the Electric Eel have been seen that were upwards of twenty feet in length, and whose shock was instant death to any man that unluckily received it: but this is contradicted by captain Stedman, whose long residence in Surinam enabled him to make accurate inquiries on the subject.

These Eels are caught in Guiana when very young, and are often preserved there in large troughs filled with water, by way of amusement. They are usually fed with small fish, earth-worms, or cockroaches, the latter of which are the most agreeable of all food to them: when one of these is thrown into the trough, the fish opens his mouth and sucks it in with great avidity and apparent pleasure.—From the skin is excreted a slimy substance, which renders it necessary to have the water often changed.—When the water is out of the trough they will lie motionless for several hours; but, if touched in this condition, they never fail to communicate a violent shock*.

THE SWORD-FISH TRIBE.

The head of the Sword-fish is furnished with a long, hard, sword-shaped upper jaw. The mouth has no teeth. The gill membrane is eight-rayed; and the body is rounded, and has no apparent scales.

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* *Bancroft*, 200.

THE BROAD-FINNED SWORD-FISH*.

This species of Sword-fish inhabits the Brasilian and East Indian Seas, and also the Northern Ocean. The body is of a silvery blueish white, except on the upper parts of the back, the head and tail, which are of a deep brown. The skin is smooth, and without any appearance of scales. From the long sharp-pointed process of the head, it would seem, on a cursory view, to be allied to the European species; but it differs from this in having an extremely broad back-fin, and two long sharp-pointed appendages proceeding from the thorax. It frequently grows to the length of twenty feet and upwards, and is a very powerful fish.

When his majesty's ship Leopard, after her return from the coast of Guinea and the West Indies, was ordered, in 1725, to be cleaned and refitted for the Channel service, in stripping off her sheathing the ship-wrights found in her bottom, pointing in a direction from the stern towards the head, part of the sword or snout of one of these fishes. On the outside this was rough, not unlike seal-skin, and the end, where it was broken off, appeared like a coarse kind of ivory. The fish is supposed to have followed the ship when under sail, from the direction in which this sword lay. It had penetrated through the sheathing, which was an inch thick, passed through three inches of plank, and beyond that, four inches and a half, into the timber. The force requisite to effect this (since the vessel sailed in a direction from the fish) must have been excessively great, especially as no shock was felt by the persons on board. The workmen on the spot declared it impossible, with a hammer of a quarter of an hundred weight, to drive an iron pin of the same form and size into that wood, and to the same depth, in less than eight or nine strokes, whilst this had been effected by only one *.

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* SYNONYMS.—Xiphias platypterus. *Shaw.*—Indian Sword-fish. *Sword-fish, Var.*—Broad-finned Sword-fish.—*Shaw's Nat. Mis.*

And about sixteen years ago a letter was written to Sir Joseph Banks as president of the Royal Society from the captain of an East-Indiaman, accompanied with an account of another instance of the amazing strength which this fish occasionally exerts—the bottom of his ship being pierced through in such a manner that the sword was completely embedded, or driven through its whole length, and the fish killed by the violence of the effort. A part of the bottom of the vessel, with the sword embedded in it, is now lodged in the British Museum †.

The Sword-fish and the Whale are said never to meet without coming to battle; and the former has the name of being always the aggressor. Sometimes two of them join against one whale, in which case the combat is by no means equal. The whale uses his tail only in his defence: he dives down into the water, head foremost, and makes such a blow with this, that, if it takes effect, finishes the Sword-fish at a stroke: but the other, who is generally sufficiently adroit to avoid it, immediately falls upon the whale, and buries his weapon in his sides. When the Whale

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* Mortimer in Phil. Tran. vol. xli. p. 862.

† Shaw's Nat. *Mis. iii. t. 88.*

discovers the Sword-fish darting upon him, he dives to the bottom, but is closely pursued by his enemy, who obliges him again to rise to the surface. The battle then begins afresh, and lasts till the Sword-fish loses sight of the Whale, who is at length compelled to swim off, which his superior agility allows him to do. In the Sword-fish piercing the Whale's body with the tremendous weapon at his snout, he seldom does any great damage to the animal, from not being able to penetrate much beyond the fat.

JUGULAR FISH*.

THE COD TRIBE.

THE head in the Cod-fish is smooth; and the gill-membrane has seven rays. The body is oblong, and covered with deciduous scales. The fins are all covered with the common skin. The rays of the fins are unarmed; and the ventral fins are slender, and terminate in a point.

The number of species is about *twenty-four.*

THE COMMON COD †.

These fish are found only in the ocean, in the northern parts of the world: and the great rendezvous for them are the sand-banks of Newfoundland, Nova Scotia and New England. These shallows are their favourite situations; for here they are able to obtain great quantities of worms, a food that is peculiarly grateful to them. Another cause of their attachment to these places, is their vicinity to the polar seas, where they return to spawn. There they deposit their roes in full security, and afterwards repair, as soon as the first more southern seas are open, to the banks for subsistence.—Few are taken north of Iceland, and the shoals never reach so far south as the straits of Gibraltar.

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* This is the second of the Linnean orders of fishes.

† Gadus morhua. *Linn.*

Prior to the discovery of Newfoundland, the principal fisheries for Cod were in the seas off Iceland, and off the western islands of Scotland. To the former of these the English resorted near four hundred years ago. In the reign of James the first, we had no fewer than 150 vessels employed in the Iceland fishery.

The chief fisheries now are in the Bay of Canada, on the great bank of Newfoundland, and off the isle of St. Peter, and the isle of Sable. The vessels frequenting these fisheries are of from a hundred to two hundred tons burthen, and will catch 30,000 Cod or upwards each. The hook and line are the only implements used to take the fish; and this in a depth of water of from sixteen to sixty fathoms.—The great bank of Newfoundland is represented to be like a vast mountain, above five hundred miles long, and near three hundred broad; and the number of British seamen employed upon it is supposed to be about fifteen thousand.

The best season for fishing is from the beginning of February to the end of April; and though each fisherman takes no more than one fish at a time, an expert hand will sometimes catch four hundred in a day. The employment is excessively fatiguing, from the weight of the fish, and the great coldness on the bank.

As soon as the Cod are caught, the heads are cut off; they are opened, gutted and salted: they are then stowed in the hold of the vessel, in beds five or six yards square, head to tail, with a layer of salt to each layer of fish. When they have lain here three or four days to drain off the water, they are shifted into a different part of the vessel, and again salted. Here they remain till the vessel is loaded. Sometimes they are cut into thick pieces, and packed in barrels, for the greater convenience of carriage.

Cod are taken by the natives of Norway, off their own coast, in strong pack-thread nets. These have meshes four inches square, and are about a fathom or fifteen meshes deep, and twenty fathom long. They use, according to the weather, from eighteen to twenty-four of these nets joined, so that they have sometimes upwards of four hundred fathom of net out at a time. They fish in from fifty to seventy fathom water, and mark the places of the nets by means of buoys. The afternoon is the time when the nets are generally set; and on taking them in on the following morning, it is no uncommon thing to obtain three or four hundred fine Cod*.

In the Newfoundland fishery, the *sounds* or air-bladders are taken out previous to incipient putrefaction, washed from their slime, and salted for exportation. The tongues are also cured, and brought in barrels containing four or five hundred pounds weight each. From the livers a great quantity of oil is extracted.

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* Pontoppidan, *part* ii. p. 158.

These fish feed principally on the smaller species of the scaly tribes, on worms, shell-fish and crabs: and their digestion is sufficiently powerful to dissolve the greatest part even of the shells which they swallow. They are very voracious, and catch at any small body they observe moved by the water, even stones and pebbles, which are often found in their stomachs.

They are so extremely prolific, that Leeuwenhoek counted above nine millions of eggs in the roe of a middling-sized Cod-fish. The production of so great a number will surely baffle all the efforts of man, or the voracity of the inhabitants of the ocean, to diminish the species so greatly, as to prevent its affording an inexhaustible supply of grateful provision in all ages.

In the European seas the Cod begin to spawn in January, and they deposit their eggs in rough ground among rocks. Some continue in roe till the beginning of April. They recover very quickly after spawning, and good fish are to be taken all the summer. When they are out of season, they are thin-tailed and lousy. Cod-fish are chosen for the table, by their plumpness and roundness near the tail; by the depth of the hollow behind the head, and by the regular undulated appearance of the sides, as if they were ribbed. The glutinous parts about the head lose their delicate flavour, after the fish has been twenty-four hours out of the water.

The Cod frequently grow to a very great size. The largest that is known to have been taken in this kingdom, was at Scarborough, in the year 1775: it measured five feet eight inches in length, and five feet in circumference, and weighed seventy-eight pounds. The usual weight of these fish is from fourteen to forty pounds*.

THE HADDOCK †.

The Haddock, a fish that every one is acquainted with, migrates in immense shoals, that arrive on the Yorkshire coasts about the middle of winter. These are sometimes known to extend from the shore, near three miles in breadth, and in length from Flamborough head to Tinmouth castle, near fifty miles, and perhaps even much farther northwards. An idea of their numbers may be had from the following circumstance: Three fishermen, within a mile of the harbour of Scarborough, frequently loaded their boat with them twice a day, taking each time about a ton of fish. The large ones quit the coast as soon as they are out of season, and leave behind them great plenty of small ones: the former are supposed to visit the coasts of Hamburgh and Jutland during the summer.

The larger ones begin to be in roe in November, and continue so for somewhat more than two months: from this time till May they are reckoned out of season, and are not good. They then begin to recover. The small ones are extremely good from May till

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* Penn. Brit. Zool. iii. 172.

† Gadus Oglesinus. *Linn.*

February; and those that are not old enough to breed, for even two months afterwards.

Haddocks seldom grow to any great size; they very rarely become so large as to weigh twelve or fourteen pounds; and they are esteemed more delicate eating when they do not exceed three pounds in weight.

During stormy weather, these fish are said to take shelter in the sand or mud, or among the sea-weeds. They feed on various small marine animals, and frequently become fat on herrings. The females deposit their spawn on the fuci or sea-weeds near the shore.

On each side of the body, just beyond the gills, is a dark spot. Superstition asserts that when St. Peter took the tribute money out of the mouth of a fish of this species, he left the impression of his finger and thumb, which has ever since been continued to the whole race of Haddocks*.

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* Penn. Brit. Zool. iii. 179.

THORACIC FISH*.

THE SUCKING-FISH TRIBE.

THE Sucking-Fishes have the head flat, oily, and depressed: this is also margined and transversely streaked or grooved. They have ten rays in the gill-membrane, and the body is destitute of scales.

THE COMMON SUCKING-FISH†.

This singular animal is usually about a foot in length, and has sixteen or more furrows on the top of the head. The back is convex and black, and the belly white. The tail is forked.

It inhabits most parts of the ocean, and is often found so strongly adhering to the sides of sharks and other fish, by means of the structure of its head, as not to be got off without great difficulty. Five of them have been taken from the body of a single shark‡. St. Pierre says, he has put some of them on an even surface of glass, from which he could not afterwards remove them§.

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[*] This is the third of the Linnean orders of fishes.

[†] Echeneis remora. *Linn.*

[‡] Catesby, ii. 26.

[§] *Voyage to the Isle of France, 30.*

The antients believed the Sucking-fish, small as it is, to possess the powers of arresting the progress of a ship in its fastest sailing, by adhering to its bottom.

The sucking-fish beneath, with secret chains,
Clung to the keel, the swiftest ship detains.
The seamen run confused, no labour 's spar'd,
Let fly the sheets, and hoist the top-mast yard.
The master bids them give her all the sails,
To court the winds, and catch the coming gales.
But, though the canvas bellies with the blast,
And boisterous winds bend down the cracking mast,
The bark stands firmly rooted in the sea,
And will, unmov'd, nor winds nor waves obey;
Still, as when calms have flatted all the plain,
And infant waves scarce wrinkle on the main.
No ship in harbour moor'd so careless rides,
When ruffling waters tell the flowing tides.
Appall'd, the sailors stare, through strange surprise,
Believe they dream, and rub their waking eyes.
As when, unerring from the huntsman's bow,
The feather'd death arrests the flying doe,
Struck through, the dying beast falls sudden down,
The parts grow stiff, and all the motion 's gone;
Such sudden force the floating captive binds,
Though beat by waves, and urged by driving winds*.

Turning its powers in a very different way, the antients also fancied, that in what manner soever it was administered, it was fatal in affairs of love, deadening the warmest affections of both sexes†.

The Indians of Jamaica and Cuba formerly used the Sucking-fish in the catching of others, somewhat in the same manner as hawks are employed by a faltoner. They kept them for the purpose, and had them regularly fed. The owner on a calm morning, would carry one of them out to sea, secured to his canoe by a small but strong line many fathoms in length; and the moment the creature saw a fish in the water, though at a great distance, it would dart away with the swiftness of an arrow, and soon fasten upon it. The Indian in the mean time loosened and let go the line, which was provided with a buoy that kept on the surface of the sea, and marked the course the Sucking-fish had taken; and he pursued it in his canoe, until he perceived his game to be nearly exhausted and run down.—He then, taking up the buoy, gradually drew the line towards the shore; the Sucking-fish still adhering with so inflexible a tenacity to his prey, as not easily to be removed. Oviedo says he has known turtle taken by this mode of a bulk and weight that no single man could support.

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* Jones's translation of Oppian.

† Pliny, lib. ix. c. 25.

These fish are often eaten, and in taste they are said very greatly to resemble fried artichokes*.

THE FLAT-FISH.

The present tribe comprehends those fish that are usually denominated Flat-fish, as the Plaise, Flounder, Sole, &c. These are generally confined to the muddy or sandy banks of the sea, where they have the power of burying themselves, as far as the head, to escape the devastations of the more rapacious tribes. They are not able to rise from the bottom, from the want of an air-bladder to buoy them up, which most of the other fishes possess; here they swim with their bodies in an oblique position, and feed on such aquatic worms, &c. as come in their way.

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* St. Pierre's Isle of France, 30.

Many of them, as the Holibut, Turbot, &c. grow to a great size. The eyes of the whole genus are situated on one side of the head. It is a curious circumstance, that while the under parts of their body are of a brilliant white, the upper parts are so coloured and speckled, as, when they are half immersed in the sand or mud, to render them imperceptible. Of this resemblance they are so conscious, that, whenever they find themselves in danger, they sink into the mud and continue perfectly motionless. This circumstance is so well known to fishermen, that within their palings on the strand they are often under the necessity of tracing furrows with a kind of iron sickle, to detect by the touch what they are not otherwise able to distinguish. Not being rapacious, or furnished with any weapons of defence, these fishes owe their security to this stratagem; while the Thornback and Rays, that are carnivorous and armed with strong spines, although flat-fish of a different class, are marbled with lighter colours, that they may be perceived and avoided by less powerful fish.

THE TURBOT*.

The northern parts of the English coast, and some places off the coast of Holland, afford Turbots in greater abundance and in greater excellence than any other parts of the world. Lying here in deep waters they are seldom to be taken but by lines.

In fishing for Turbot off the Yorkshire coast, three men go out in each of the boats, each man provided with three lines, every one of which is furnished with two hundred and eighty hooks, placed exactly six feet two inches asunder. These are coiled on an oblong piece of wicker-work, with the hooks baited and placed very regularly in the centre of the coil. When they are used, the nine are generally fastened together so as to form one line with above two thousand hooks, and extending near three miles in length: this is always laid across the current. An anchor and buoy are fixed at the end of each man's line. The tides run here so rapidly that the fishermen can only shoot and haul their lines in the still water at the turn of the tide; and therefore, as it is flood and ebb about every alternate six hours, this is the longest time the lines can remain on the ground. When the lines are laid, two of the men usually wrap themselves in the sail and sleep, while the third is on watch to prevent their being run down by ships, and to observe the weather; for sometimes storms come on so suddenly that they find it difficult to gain the shore even without their lines.

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* Pleuronectes maximus. *Linn.*

The boats used in this work are each about a ton burthen; somewhat more than twenty feet in length, and about five in width. They are well constructed for encountering a boisterous sea, and have three pairs of oars, and a sail, to be used as occasion requires. Sometimes larger boats than these are used, which carry six men and a boy. When the latter come to the fishing-ground they put out two of the smaller boats that they have on board, which fish in the same manner as the three manned boats do, save that each man is provided with a double quantity of lines; and instead of waiting in these the return of the tide, they return to the large boat and bait their other lines: thus hauling one set and shooting another at every turn of the tide. The fishermen commonly run into harbour twice a week to deliver their fish.

The bait that the Turbots take most readily is fresh herring cut into proper-sized pieces: they are also partial to the smaller lampreys, pieces of haddock, sand-worms, muscles and limpets; and when none of these are to be had, the fishermen use bullock's liver. The hooks are two inches and a half long in the shank, and near an inch wide betwixt the shank and the point. They are fastened to the lines upon sneads of twisted horse-hair, twenty-seven inches in length. The line is made of small cording, and is always tanned before it is used*.—The Turbots are so extremely delicate in their choice of baits as not to touch a piece of herring or haddock that has been twelve hours out of the sea.

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* For the tanning of nets and lines see the ensuing account of the Herring.

The greatest weight of these fish is about thirty pounds.

In many parts of this country Turbot and Holibut are sold indiscriminately for each other: they are, however, perfectly distinct, the upper parts of the former being marked with large, unequal, and obtuse tubercles, while those of the other are quite smooth, and covered with oblong soft scales that adhere firmly to the body[*].

THE SOLE[†].

In the economy of the Sole we have one circumstance that is very remarkable: among various other marine productions they have been known to feed on shell-fish, although they possess no apparatus whatever in their mouth for reducing them to a state calculated for digestion. Some that were purchased by Mr. Collinson had their bellies hard and prominent, appearing to be filled with rows of some hard substance, which on being opened were found to be shell-fish. These, from the bulging of the shells and the intervening interstices, gave the intestines somewhat the appearance of strings of beads. On further examination some of them were found nearly dissolved, others partly so, but many of them were whole[‡]. The most usual food of the Soles is the spawn and young of other fish.

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[*] Penn. Brit. Zool. iii. 233.

[†] Pleuronectes Solea. *Linn.*

[‡] Collinson on the Food of Soles, Phil. Tran. vol. xliii. p. 37.

Soles are found on all the British coasts: but those of the western shores are much superior in size to what are taken in the north, since they are sometimes found of the weight of six or seven pounds. The principal fishery for them is in Torbay.

THE CHÆTODON TRIBE.

In this tribe, though the species are very numerous, there is only one of which we have found any account in the least degree interesting; arising principally from their being inhabitants of distant waters, in hot climates, and many of them but seldom seen.

Their head and mouth are small, and they have the power of pushing out and retracting the lips, so as to make a tubular orifice. The teeth are, mostly, bristle-shaped, flexile, moveable, closely set, and very numerous. The gill-membrane has from three to six rays. The body is scaly, broad, and compressed; and the dorsal and anal fins are generally terminated with prickles.

THE BEAKED CHÆTODON*.

The Beaked Chætodon or Shooting-fish frequents the shores and mouths of rivers in India, and about the Indian islands. It is about six inches in length, and is of a whitish or very pale brown colour, with, commonly, four or five blackish bands running across the body, which is ovate and compressed. The snout is lengthened and somewhat cylindrical. The dorsal and anal fins are very large, and on the former is a large eye-like spot.

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* Synonyms.—Chætodon rostratus. *Linn.*—Chætodon enceladus. *Shaw.*—Jaculator or Shooting-fish. *Phil. Tran.*—Beaked Chætodon. *Shaw.*

This fish feeds principally on flies and other small winged insects that hover about the waters it inhabits; and the mode of taking its prey is very remarkable. When it sees a fly at a distance alighted on any of the plants in the shallow water, it approaches very slowly, and with the utmost caution, coming as much as possible perpendicularly under the object. Then putting its body in an oblique direction, with the mouth and eyes near the surface, it remains a moment immoveable. Having fixed its eyes directly on the insect, it shoots at it a drop of water from its tubular snout, but without showing its mouth above the surface, from whence only the drop seems to rise. This is done with so much dexterity, that though at the distance of four, five, or six feet, it very seldom fails to bring the fly into the water. With the closest attention the mouth could never be discovered above the surface, although the fish has been seen to eject several drops, one after another, without leaving the place, or in the smallest apparent degree moving its body.

This very singular action was reported to M. Hommel, the governor of the hospital at Batavia, near which place the species is sometimes found; and so far raised his curiosity, that he was determined, if possible, to convince himself of its truth by ocular demonstration.

For this purpose he ordered a large wide tub to be filled with sea-water; he then had some of these fish caught and put into it, and the water was changed every other day. After a while they seemed reconciled to their confinement; and he then tried the experiment. A slender stick, with a fly fastened at the end, was placed in such a manner on the side of the vessel, as to enable the fish to strike it: and it was not without inexpressible delight that he daily saw them exercising their skill in shooting at it, with amazing force, and seldom missing their mark*.

The flest of this species is white and well tasted.

THE STICKLEBACKS.

In the Sticklebacks the head is somewhat oblong and smooth, having the jaws armed with minute teeth. The gill-membrane has either three, six, or seven rays. The body is keel-shaped towards the tail, and covered with bony plates. On the back betwixt the dorsal fin and the head are several sharp spines.

The species, which are not very numerous, are dispersed over various parts of the world, some inhabiting the fresh waters, and others being entirely marine. The manners of the former may in a great measure be collected from those of the following species.

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* Phil. Tran. vol. liii. p. 89, and vol. lvi. p. 186.

THE THREE-SPINED STICKLEBACK*.

These little fish, which seldom exceed two inches in length, are very common in many of our rivers. They have three sharp spines on their back, which are their instruments both of offence and defence, and are always erected on the least appearance of danger, or whenever they are about to attack other fish. The body near the tail is somewhat square, and the sides are covered with transverse bony plates. Their usual colours are olive green above and white on the under parts; but in some individuals the lower jaw and the belly are of a bright crimson.

By feeding with great voracity on the fry and spawn of other fish, they are greatly detrimental to the increase of almost all the species among which they inhabit. One that Mr. Arderon of Norwich had in a glass devoured in five hours no fewer than seventy-four young dace, each about an inch and a half long, and of the thickness of a horse-hair, and would have done the same every day had they been given to it.

This fish was put by Mr. Arderon into a glass jar of water, with some sand at the bottom for the purpose of trying some experiments on it, as well as for the purpose of ascertaining its manners, as far as possible in a confined state. For a few days it refused to eat; but by frequently giving it fresh water, and by coming often to it, it began to eat the small worms that were now and then thrown into the jar; soon afterwards it became so familiar as to take them from the hand; and at last it even became so bold, as, when it was satiated, or did not like what was offered to it, to set up its prickles and strike with its utmost strength at the fingers, if put into the water to it. It would suffer no other fish to live in the same jar, attacking whatever were put in, though ten times its own size. One day by way of diversion a small fish was put to it. The Prickleback immediately assaulted and put it to flight, tearing off part of its tail in the conflict; and had they not been then separated, he would undoubtedly have killed it*.

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* SYNONYMS.—Gasterosteus aculeatus. *Linn.* — Stickleback, Bansticle, Sharpling. *Willughby's Ich.*—Prickle-back, Prickle-bag. *Phil. Tran.*——*Penn. Brit. Zool. vol.* 3. *tab.* 50.

Small as these animals are, they are sometimes so numerous as to be obliged to colonize, and leave their native places in search of new habitations. Once in every seven or eight years they appear in the river Welland, near Spalding in Lincolnshire, in such amazing shoals, as, during their progress up the stream, to appear in the form of a vast column. These are supposed to be the overplus of multitudes collected in some of the fens. When this happens they are taken as manure for the land; and an idea may be formed of their numbers from the circumstance, that a man employed by a farmer to catch them, got, for some time, four shillings a day by selling them at a halfpenny a bushel*.

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* Phil. Tran. vol. xliv. p. 124.

The endeavours they use, and the exertions they make, in getting from one place to another where obstacles intervene, are very extraordinary; for, though the largest among them is seldom known to be more than two inches in length, they have been seen to spring a foot and a half (nine times their own length) in perpendicular height from the surface of the water, and in an oblique direction much farther.

They spawn in April and June on the aquatic plants; and are very short-lived, scarcely ever attaining the third year. They are too small, and perhaps too bony, to be of any essential service as food to mankind; but in some parts of the Continent they are of considerable use in fattening ducks and pigs.

THE MACKREL TRIBE.

This tribe have a smooth body, and seven rays in their gill-membrane. Between the dorsal fin and the tail there are several small or spurious fins.

THE COMMON MACKREL†.

The Mackrel, when alive, from the elegance of its shape, and the extreme brilliancy of its colours, is by far the most beautiful fish that frequents our coasts. Death in some measure impairs the colours, but by no means obliterates them.

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* Penn. Brit. Zool. iii. 261.

† Synonyms.—Scomber scomber. *Linn.*—Mackrell or Mackarel. *Will. Ich.*—*Penn. Brit. Zool. vol.* 3. *tab.* 51.

It visits our shores in vast shoals; but, from being very tender and unfit for long carriage, is found less useful than other gregarious fish. In some places it is taken by lines from boats, as during a fresh gale of wind it readily takes a bait. It is necessary for the boat to be in motion in order to drag the bait along (a bit of red cloth, or a piece of the tail of a Mackrel) near the surface of the water. In some parts of the West of England Mackrel are fished for with nets. One man fixes a pole into the sand near the sea, to which he fastens one end of a long net. Another in a boat takes the other end of the net, and rows round in a circuit as far as the length of the net will allow, and then to the shore. He runs the boat aground; then stepping into the water drags the net ashore; and on a signal given, they both together haul it out of the sea, and thus often catch three or four hundred fish.

Mackrel are said to be fond of human flesh. Pontoppidan informs us, that a sailor belonging to a ship lying in one of the harbours on the coast of Norway, went into the water to wash himself; when he was suddenly missed by his companions. In the course of a few minutes, however, he was seen on the surface with vast numbers of these fish fastened on him. The people went in a boat to his assistance; and though, when they got him up, they forced with some difficulty the fishes from him, they found it was too late; for the poor fellow, very shortly afterwards, expired*.

The roes of the Mackrel are used in the Mediterranean for *Caviar*. The blood and slime are first washed off with vinegar, and the sinews and skinny parts taken away. They are then spread out for a short time to dry, and afterwards salted and hung up in a net, to drain some of the remaining moisture from them. When this is finished they are laid in a kind of sieve till thoroughly dry and fit for use. In Cornwall and on several parts of the Continent the Mackrel are preserved by means of pickling and salting.

Their greatest weight seldom exceeds two pounds, though some have been seen that weighed more than five. Their voracity has scarcely any bounds; and when they get among a shoal of herrings they make such havoc as frequently to drive it away. They are very prolific, and deposit their spawn among the rocks near the shore, about the month of June. They die very soon after they are taken out of the water, and for a short time exhibit a phosphoric light.

In spring their eyes are almost covered with a white film, that grows in the winter and is regularly cast at the beginning of summer. During this time they are said to be nearly blind.

The celebrated *Garum* of the Romans was a pickle prepared from this fish.

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* Pontoppidan, part ii. 135.

THE THUNNY*.

The Thunny was a fish so well known to the antients as to form one of the great articles of their commerce. It is found in most seas, and is from two to ten feet long. The body is round and thick, and tapers nearly to a point both at the head and tail. The skin of the back is very thick and black, and that of the sides and belly silvery, tinged with light blue and pale purple. The tail is crescent-shaped, with the tips far asunder; and the spurious fins between the dorsal fin and the tail (which mark the species) are from eight to eleven in number.

On the coasts of Sicily, as well as in several other parts of the Mediterranean, there are now very considerable Thunny fisheries. The nets are spread over a large space of sea by means of cables fastened to anchors, and are divided into several compartments. A man placed upon the summit of a rock high above the water, gives the signal of the fish being arrived; for he can discern from that elevation what passes under the water infinitely better than any person nearer the surface. As soon as notice is given that a shoal of fish has penetrated as far as the inner compartment of the net, the passage is drawn close, and the slaughter begins.

The Thunny enters the Mediterranean about the vernal equinox, travelling in a triangular phalanx, so as to cut the waters with its point, and to present an extensive base for the tides and currents to act against, and impel forwards.

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* SYNONYMS.—Scomber thynnus. *Linn.* — Albicore. *Var.*— Mackrel-sture, or Great Mackrel, in Scotland.—Tunny Fish, or Spanish Mackrell. *Will. Icb.*——*Penn. Brit. Zool. vol. 3. tab. 52.*

They repair to the warm seas of Greece to spawn, steering their course thither along the European shores; but as they return they approach the African coast: the young fry is placed in the van of the squadron as they travel. They come back from the east in May, and abound about that time on the coasts of Sicily and Calabria. In autumn they steer northward, and frequent the neighbourhood of Amalphi and Naples. They are not uncommon on the western coasts of Scotland, where they come in pursuit of the herrings, and often during the night strike into the nets and do considerable damage. When the fishermen draw these up in the morning, the Thunny rises at the same time towards the surface, ready to catch the fish that drop out. On its being observed, a line is thrown into the water having a strong hook baited with a herring, which it seldom fails to seize. As soon as the fish finds itself ensnared it seems to lose all its active powers, and, after very little resistance, submits to its fate.

The quantity of these fish that is annually consumed in the two Sicilies almost exceeds the bounds of calculation. When taken in May they are full of spawn, and are then esteemed unwholesome, as being apt to occasion headachs and vapours: to prevent in some measure these bad effects, the natives fry them in oil, and afterwards salt them. The pieces when fresh appear exactly like raw beef: but when boiled they turn pale, and have somewhat the flavor of salmon. The most delicate parts are about the muzzle. What the inhabitants are not able to use immediately are cut into slices, salted, and preserved in large tubs, either for sale or winter provisions.

The Romans held them in great estimation.

ABDOMINAL FISH*.

THE SALMON TRIBE.

RAPID and stony rivers, where the water is free from mud, are the favourite places of most of the Salmon tribe. Some of them do indeed inhabit the sea, but they come up the rivers for the purpose of depositing their spawn in the beds of gravel; and in this instinctivepursuit they will surmount wonderful obstacles that oppose their course. After spawning they return to the sea lean and emaciated. The whole tribe is supposed to be wholesome food for mankind.

They are distinguished from other fishes by having two dorsal fins, of which the hindmost is fleshy and without rays. They have teeth both in the jaws and on the tongue; and the body is covered with round and minutely striated scales.

THE COMMON SALMON†.

This fish seems confined in a great measure to the northern seas, being unknown in the Mediterranean, and in the waters of other warm climates. It lives in fresh as well as in salt waters, forcing itself in autumn up the rivers, sometimes for hundreds of miles, for the purpose of depositing its spawn. In these peregrinations it is that salmon are taken in the great numbers that supply our markets and tables. Intent only on the object of their journey, they spring up cataracts and over other obstacles of a very great height. This extraordinary power seems to be owing to a sudden jerk that the fish gives to its body from a bent into a straight position. When they are unexpectedly obstructed in their progress, it is said they swim a few paces back, survey the object for some minutes motionless, retreat, and return again to the charge; then collecting all their force, with one astonishing spring overleap every obstacle. Where the water is low, or sand-banks intervene, they throw themselves on one side, and in that position soon work themselves over into the deep water beyond. On the river Liffey in Ireland there is a cataract about nineteen feet high; here in the salmon season many of the inhabitants amuse themselves in observing the fish leap up the torrent. They frequently fall back many times before they surmount it, and baskets made of twigs are placed near the edge of the stream to catch them in their fall.—At the falls of Kilmorack in Scotland, where the salmon are very numerous, it is a common practice with the country people to lay branches of trees on the edges of the rocks, and by this means they often take such of the fish as miss their leap, which the foaming of the torrent not unfrequently causes them to do. And the late lord Lovat, who often visited these falls, taking the hint from this circumstance, formed a determination to try a whimsical experiment on the same principle. Alongside one of the falls he ordered a kettle full of water to be placed over a fire, and many minutes had not elapsed before a large salmon made a false leap and fell into it. This may seem incredible to those who never saw one of these rude salmon-leaps; but surely there is as great a chance of a Salmon falling into a kettle as on any given part of the adjacent rock, and it is a thing that would take place many times in the course of the season were but the experiment tried.

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* This is the fourth of the Linnean orders of fishes.

† Salmo Salar. *Linn.*

When the Salmon have arrived at a proper place for spawning in, the male and female unite in forming in the sand or gravel a proper receptacle for their ova, about eighteen inches deep, which they are also supposed afterwards to cover up. In this hole the ova lie till the ensuing spring, (if not displaced by the floods,) before they are hatched. The parents however, immediately after their spawning, hasten to the salt water, now extremely emaciated. Toward the end of March the young fry begin to appear, and gradually increasing in size, become in the beginning of May five or six inches in length, when they are called *Salmon-smelts*. They now swarm in the rivers in myriads; but the first flood sweeps them down into the sea, scarcely leaving any behind. About the middle of June the largest of these begin to return into the rivers: they are now become of the length of twelve or sixteen inches. Towards the end of July they are called *Gilse*, and weigh from six to nine pounds each.

When the Salmon enter the fresh water they are always more or less infested with a kind of insect called the salmon-louse *; when these are numerous the fish are esteemed in high season. Very soon after the Salmon have left the sea these insects die and drop off.

After the fish have become lean at the spawning-time, on their return to the sea they acquire their proper bulk in a very short time; having been known to considerably more than double their weight in about six weeks.

Their food is other fish, insects, and worms; for all these are used with success, as baits, by the anglers for Salmon.

The principal fisheries in Europe are in the rivers, or on sea-coasts adjoining to the large rivers, of England, Scotland, and Ireland. The chief English rivers for them are the Tyne, the Trent, the Severn, and the Thames. They are sometimes taken in nets, and sometimes by means of locks or weirs with iron or wooden grates, so placed in an angle, that, being impelled by any force in a direction contrary to that of the stream, they open, let the fish (or whatever else pushes against them) through, and again by the force of the water or their own weight close and prevent their return. Salmon are also killed in still water, by means of a spear with several prongs, which the fishermen use with surprising dexterity. When this is used in the night a candle and lantern, or a wisp of straw set on fire, is carried along, to the light of which the fish collect.

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* Lernæa Salmonea of Linnæus.

In the river Tweed, about the month of July, the capture of Salmon is astonishing: often a boat-load and sometimes near two may be taken at a tide; and in one instance above seven hundred fish were caught at a single haul of the net. From fifty to a hundred at a haul is very common. Most of those that are taken before the setting-in of the warm weather are sent fresh to London, if the weather will permit: the others are salted, pickled or dried, and are sent off in barrels, in quantities sufficient not only to stock the London markets, but also some of the markets of the continent; for the former are by no means able to take all the fish that are caught here.

The season for fishing commences in the Tweed on the thirtieth of November, and ends about old Michaelmas-day. On this river there are above forty considerable fisheries, which extend upwards about fourteen miles from the mouth; besides many others of less consequence. These several years ago were rented at above the annual sum of ten thousand pounds; and to defray this expence it has been calculated that more than 200,000 salmon must be caught there one year with another.

The Scotch fisheries are very productive; as are also several of those in Ireland, particularly that at Cranna on the river Ban, about a mile and a half from Coleraine. At this place in the year 1760 as many as three hundred and twenty tons were taken.

A person of the name of Graham, who farms the sea-coast fishery at Whitehaven, has adopted a successful mode of taking Salmon, which he has appropriately denominated *Salmon-hunting*. When the tide is out, and the fish are left in shallow waters, intercepted by sand-banks, near the mouth of the river; or when they are found in any inlets up the shore, where the water is not more than from one foot to four feet in depth, the place where they lie is to be discovered by their agitation of the pool. This man, armed with a three-pointed, barbed spear, with a shaft of fifteen feet in length, mounts his horse, and plunges, at a swift trot, or moderate gallop, belly deep, into the water. He makes ready his spear with both hands; when he overtakes the Salmon, he lets go one hand, and with the other strikes the spear, with almost unerring aim, into the fish: this done, by a turn of the hand he raises the Salmon to the surface of the water, turns his horse's head to the shore, and runs the Salmon on dry land without dismounting. This man says, that by the present mode he can kill from forty to fifty in a day; ten are however no despicable day's work for a man and horse. His father was probably the first man that ever adopted this method of killing Salmon on horseback.

Salmon are cured by being split, rubbed with salt, and put in pickle in tubs provided for the purpose, where they are kept about six weeks: they are then taken out, pressed, and packed in casks, with layers of salt *.

Different species of Salmon come in so great abundance up the rivers of Kamtschatka, as to force the water before them, and even to dam up the streams in

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* Penn. Brit. Zool. iii. 284.

such manner as sometimes to make them overflow their banks. In this case, when the water finds a passage, such multitudes are left on the dry ground, as would, were it not for the violent winds so prevalent in that country, assisted by the bears and dogs, soon produce a stench sufficiently great to cause a pestilence*.

Salmon are said to have an aversion to any thing red, so that the fishermen are generally careful not to wear jackets or caps of that colour. Pontoppidan says also, that they have so great a dislike to carrion, that, if any happens to be thrown into the places where they are, they immmediately forsake them: the Norwegian remedy for this, which is looked upon by the inhabitants as an effectual one, is to throw into the water a lighted torch †.

THE PIKE TRIBE.

In the whole of the Pike genus the head is somewhat flat, and the upper jaw shorter than the other. The gill-membrane has from seven to twelve rays. The body is long, slender, compressed at the sides, and covered with hard scales. The dorsal fin is situated near the tail, and generally opposite to the anal fin.

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* Penn. Introd. to Arct. Zool. p. cxxiii.

† Pontoppidan, part ii. 133.

THE COMMON PIKE*.

These fish are found in considerable plenty in most of the lakes in Europe, Lapland, and the northern parts of Persia, where they sometimes measure upwards of eight feet in length.

There is scarcely any fish of its size in the world that in voracity can equal the Pike. One of them has been known to choak itself in attempting to swallow another of its own species that proved too large a morsel; and it has been well authenticated, that in lord Gower's canal at Trentham, a Pike seized the head of a swan as she was feeding under water, and gorged so much of it as killed them both †.

"I have been assured (says Walton) by my friend Mr. Seagrave, who keeps tame otters, that he has known a pike in extreme hunger fight with one of his otters for a carp that the otter had caught, and was then bringing out of the water."

Boulker, in his Art of Angling, p. 9, says, that his father caught a pike that was an ell long, and weighed thirty-five pounds, which he presented to lord Cholmondeley. His lordship directed it to be put into a canal in his garden, which at that time contained a great quantity of fish. Twelve months afterwards the water was drawn off, and it was discovered that the pike had devoured all the fish except a single large carp, that weighed between nine and ten pounds, and even this had been bitten in several places. The pike was again put in, and an entire fresh stock of fish for him to feed on; all these he devoured in less than a year. Several times he was observed by workmen, who were standing near, to draw ducks and other water-fowl under water. Crows were shot and thrown in, which he took in the presence of the men. From this time the slaughter-men had orders to feed him with the garbage of the slaughter-house; but being afterwards neglected, he died, as it is supposed, from want of food.

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* Synonyms.—Esox lucius. *Linn.*—Pike or Pickerell.—*Will. Icb.*——*Penn. Brit. Zool. vol. 3. tab.* 63.

† Penn. Brit. Zool. vol. iii. p. 321.

In December, 1765, a pike was caught in the river Ouse that weighed upwards of twenty-eight pounds, and was sold for a guinea. When it was opened, a watch with a black ribband and two seals were found in its body. These, it was afterwards discovered, had belonged to a gentleman's servant, who had been drowned in the river about a month before*.

Gesner relates, that a famished pike in the Rhone seized on the lips of a mule, and was, in consequence, dragged out of the water; and that people while washing their legs had been bitten by these voracious creatures.

The smaller fish exhibit the same fear of this tyrant as some of the feathered tribe do of the rapacious birds, sometimes swimming round him, while lying dormant near the surface, in vast numbers, and with great anxiety†.

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* Walton, note, p. 135, from a London paper of the second of January, 1765.

† Penn. *Brit. Zool. vol. iii. 322.*

The largest pike that is supposed to have been ever seen in this country, was one taken on the draining of a pool at Lillishall lime-works, near Newport, that had not been fished in the memory of man: it weighed above 170 pounds*.

If the accounts of different writers on the subject are to be credited, the longevity of the pike is very remarkable: that however of Gesner exceeds all the rest: he mentions a pike whose age was ascertained to be 267 years.

Pikes spawn in March or April. When they are in high season, their colours are very fine, being green, spotted with bright yellow, and having the gills of a most vivid red. When out of season, the green changes to grey, and the yellow spots become pale. The teeth are very sharp, and are disposed in the upper jaw, on both sides of the lower, on the roof of the mouth, and often on the tongue. They are altogether solitary fish, never congregating like some of the other tribes.

Though somewhat bony fish, they are in general esteem as food; and on the Continent, where they are taken in great abundance, they are dried, and exported to other countries for sale.

They are often taken while lying asleep near the surface of the water, by means of a snare, at the end of a pole, gently passed over their head; which, by a sudden jerk, draws close, and brings them to land.

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* Walton, note, p. 136, from a London paper of the 25th of January, 1765.

THE MULLET TRIBE.

The body in this tribe is covered with large scales, which also extend over the gills. The lips are membranaceous; the under one carinated within. In the jaws there are no teeth, these being confined to the tongue and palate only; and the gill-membrane has six or seven curved rays.

THE COMMON MULLET*.

The head of the Mullet is almost square, and it has, between the eyes and the mouth, a kind of hard callus, or inflected tooth. In the body this fish is pretty thick, though the back is not much elevated. The upper parts are dusky, varied with blue and green; the sides and belly are silvery; the former marked with broad, dusky, parallel lines, reaching from the head to the tail. The first dorsal fin consists of five strong spines, and the tail is deeply forked†.

The Mullet is found in great plenty on several of the sandy coasts of our island, where it roots in the manner of a hog, frequently leaving large round holes on the shore. It is an active fish, and generally caught by means of a net called a trawl, which is drawn upon flat shores, touching the ground all the way: but it usually leaps over the top of the first net, and escapes, unless another net be made to follow it, which this active fish frequently overleaps also. Thus the fishermen are never certain of catching it, unless they have a third net following these two, from which it seldom escapes, being so much fatigued by its former exertions as to be unable to leap over it*.

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* Mugil Cephalus. *Linn.*——*Penn. Brit. Zool. vol.* 3. tab. 66.

† Penn. Brit. Zool. vol. iii. 332.—Linn. Gmel. i. 1397.

The following is Jones's translation of Oppian's lines on the subject of this fish, with merely the alteration of the name, for he has erroneously translated it *Barbel*.

The Mullet, when encircling seines inclose,
The fatal threads, and treach'rous bosom knows.
Instant he rallies all his vigorous powers,
And faithful aid of every nerve implores;
O'er battlements of cork up-darted flies,
And finds from air th' escape that sea denies.
But should the first attempt his hopes deceive,
And fatal space th' imprison'd fall receive,
Exhausted strength *no* second leap supplies,
Self-doom'd to death the prostrate victim lies;
Resign'd, with painful expectation waits,
Till thinner elements complete his fates.

These fish, like the herrings, are migratory. In the beginning of spring they enter the straits of Constantinople in the Black Sea, in large shoals, and follow the western shore as far as the mouth of the Don. From thence they proceed directly to the peninsula of East Tartary, and generally appear first near Koslow in the month of March. They employ three months in coasting the peninsula, and then, passing the strait Yenicalé, enter the sea of Azow, where they remain during the months of June and July. They are then three months in returning, and in their retrograde course pass as far as the canal of Constantinople, through the same places by which they arrived. From thence they are supposed to pass into the Mediterranean, where, not long afterwards, they are generally taken in abundance.

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* Anderson's Hebrides, 340.

The flesh of the Mullet is white, fat, and well-tasted. The roes are known in Italy by the name of *botargo:* they are prepared in a peculiar manner, and are greatly esteemed on the continent. When taken from the fish they are plunged, with the membrane that contains them, into a strong lye, and then left to dry. When they are supposed to be ready, they are covered with melted wax, after which they are fit for exportation, and will keep good for a considerable length of time.

The fish are most successfully caught in the Black Sea, in spring and autumn. In this fishery, as in all others, the Tartars use a kind of circular net, similar to our casting-net. They work only in the night, by the light of a piece of flaming resinous wood, which attracts the fish from all quarters to the spot, and at every cast of the net great numbers are taken*.

The Mullet is not at present a fashionable fish at the tables in this country.

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* Radcliffe, 184.

THE FLYING-FISH TRIBE.

The head is covered with scales, and the mouth is destitute of teeth. The belly is angular, and the pectoral fins are almost as long as the body.

THE WINGED FLYING-FISH*.

The Flying-fish, if we except its head and flat back, has, in the form of its body, a great resemblance to the herring. The scales are large and silvery; the pectoral fins are very long; and the dorsal fin is small, and placed near the tail, which is forked. It inhabits the European, the American, and the Red seas; but is chiefly found between the Tropics.

The wings with which these fish have the power of raising themselves into the air are nothing more than large pectoral fins, composed of seven or eight ribs or rays, connected by a flexible, transparent, and glutinous membrane. They rise near the gills, and are capable of considerable motion backwards and forwards. These fins are used also to aid their motion in the water; and if we are to judge from the great length and surface of the oars, comparatively with the size of the body, the fish should be able to cut their wa through the water with great velocity.

The Flying-fish has numerous enemies in its ow element. the Dorado, Thunny, and many others pursue and devour it. To aid its escape it is furnished with these long pectoral fins, by which it is able to raise itself into the air, where it is often seized by the Albatross or Tropic birds. Its flight is short, seldom more than sixty or seventy yards at onestretch; but by touching the surface at intervals to moisten its fins, it is able to double or treble this distance. The whole flight, however, is of so short a duration, that even in the hottest weather its fins do not become dry. By touching the water it not only wets its fins, but seems to take fresh force and vigour in another spring into an element where it is not long able to support its weight by the clumsy motion of its fins. If the Flying-fishes were solitary animals, they would not be worth the pursuit of some of their larger enemies; they are very seldom seen to rise singly from the water, but generally in large shoals.

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* Exocœtus volitans. *Linn.*——*Penn. Brit. Zool. vol.* 3. *tab.* 6

It has been inconsiderately remarked, that "all animated nature seems combined against this little fish, which possesses the double powers of swimming and flying only to subject it to greater dangers: if it escape its enemies of the deep, it is only to be devoured by the sea-fowl who are waiting its appearance in the air." Its destiny is, however, by no means peculiarly severe: we should consider that as a fish it often escapes the attack of birds; and, in its winged character, the individuals frequently throw themselves out of the power of fishes.

The eyes of these fish are so prominent as to admit of their seeing danger from whatever quarter it may come; but, on emergency, they are able, in addition, to push them somewhat beyond the sockets, so as considerably to enlarge their sphere of vision*.

They are frequently either unable to direct their flight out of a straight line, or else they become exhausted on a sudden; for sometimes whole shoals of them fall on board the ships that navigate the seas of warm climates.

In the water they possess somewhat the manner of the swallow in the air, except that they always swim in straight lines; and the blackness of their backs, the whiteness of their bellies, and their forked and expanded tails, give them much the same appearance.

They were known to the ancients; for Pliny mentions them under the name of Hirundo, and relates their faculty of flying.

THE HERRING TRIBE.

The body of the Herring is compressed, and covered with scales; and the belly is extremely sharp, sometimes forming a serrated ridge. In the gill-membrane there are eight rays. The jaws are unequal, and the upper one is furnished with serrated mystaces or connecting bones. The tail is forked.

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* Brown in Phil. Tran. vol. lxviii. p. 791.

THE COMMON HERRING*.

Herrings are found in the greatest abundance in the highest northern latitudes. In those inaccessible seas that are covered with ice for a great part of the year, they find a quiet and sure retreat from all their numerous enemies. The quantity of insects which those seas supply is immensely great. Thus remotely situated, and defended by the icy rigour of the climate, they live at ease and multiply beyond expression, coming out from thence in such shoals, that, were all the men in the world to be loaded with herrings, they could not carry off the thousandth part of them. Their enemies are however extremely numerous: all the monſters of the deep find them an easy prey; and, in addition to these, the immense flocks of sea-fowl that inhabit the polar regions, watch their outset, and spread devastation on all sides.

In their outset, this immense swarm of living creatures is divided into distinct columns of five or six miles in length, and three or four in breadth, and in their progress they make even the water ripple up before them.

They are found about Shetland in June, from whence they proceed down to the Orkneys, and then dividing, surround the islands of Great Britain and Ireland, and unite again off the Land's-end in the British channel in September, from whence the great united body steers south-west, and is not found any more on that side, or in the Atlantic, until the same time in the ensuing year, but next appear on the American coasts. They arrive in Georgia and Carolina about the latter end of January, and in Virginia in February. From hence they coast eastward to New England. They then divide, and go into all the bays, rivers, creeks, and even small streams of water, in amazing quantities, and continue spawning in the fresh water till the latter end of April, when the old fish return into the sea, where they change their latitudes by a northward direction, and arrive at Newfoundland in May. After this they are no more seen in America till the following spring. Their passing sooner or later up the American rivers, depends on the warmth of the season; and even if a few warm days invite them up, and cool weather succeeds, their passage is immediately checked till the heat becomes more powerful. Thus they are found in the British channel in September, but leave it when the sun is at too great a distance from them, and push for a more agreeable climate. And when the weather in America becomes too warm in May, (after having deposited their eggs,) they steer the course which leads to the cooler northern seas, and, by this careful change of place, perpetually enjoy the temperature of the climate best suited to their nature.

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* Clupea harengus. *Linn.*——*Penn. Brit. Zool. tab.* 68.

The young do not follow the old ones in their first migrations; for they are to be seen in great shoals in all the American bays till the autumn, when they disappear. Since it appears. that the Herrings have a natural propensity to keep at a certain distance from the sun, we may conclude that at this season of the year the young are led in a direction contrary to that of the old ones, which they meet about latitude 23° north, and 70° west longitude. Here they are supposed to tack about, and follow the others. These, being larger and stronger, come first into the American harbours, their numbers, however, considerably diminished by the devastations that have been committed among them during their absence*.

The fecundity of the Herring is astonishing: it has been calculated, that if the offspring of a single Herring could be suffered to multiply unmolested and undiminished for twenty years, they would exhibit a bulk of ten times the size of the earth. But happily Providence has so exactly contrived the balance of nature, by giving them innumerable enemies, as always to keep them within proper bounds.

In the year 1773, the Herrings were in such immense shoals, on the Scotch coasts for two months, that, it appears on pretty accurate computation, no less than 1650 boat-loads were taken in Loch Terridon every night. These would amount to near 20,000 barrels.

They once swarmed so greatly on the west side of the isle of Skye, that the numbers caught were more than could possibly be carried away. After the boats were all loaded, and the country round was served, the neighbouring farmers made them up into composts, and manured their ground with them in the ensuing season. This shoal continued to frequent the coast for many years, but not always in numbers equal to these*.

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* Gilpin on Herrings, in Amer. Phil. Tran. ii. 236.

Somewhat more than thirty years ago, the Herrings came into Loch Urn in such amazing quantities, that, from the narrows to the very head, about two miles, it was quite full. So many of them were pushed on shore, that the beach for four miles round the head was covered with them, from six to eighteen inches deep: and the ground under water, as far as could be seen when the tide was out, was equally so. So thick and so forcible was the shoal, as to carry before it every other kind of fish; even ground-fish, skate, flounders &c. were driven on the shore with the first of the Herrings, and perished there.

The principal of the British Herring fisheries are off the Scotch and Norfolk coasts; and in our seas the fishing is always carried on by nets stretched in the water, one side of which is kept from sinking, by means of buoys fixed to them at proper distances; and as the weight of the net makes the side sink to which no buoys are fixed, it is suffered to hang in a perpendicular position like a screen; and the fish, when they endeavour to pass through it, are entangled in its meshes, from which they cannot disengage themselves. There they remain till the net is hawled in, and they are shaken or picked out.

The nets are never stretched to catch Herrings but during the night, for in the dark they are to be taken in much the greatest abundance. When the night is dark, and the surface of the water considerably ruffled by the wind, the fishermen always assure themselves of the greatest success. Nets stretched in the day-time are supposed to frighten the fish away.

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* Anderson's Hebrides, 157.

In order to strengthen the nets, and render the threads more compact, they are all tanned. For this purpose a quantity of oak-bark is boiled: the liquor is then strained off and farther boiled, till it has attained such a consistence, that, when a little is dropped on the thumb-nail, it will become thick as it cools. The nets are then put into a large vessel, and this liquor is poured, while hot, upon them. They are suffered to lie four-and-twenty hours, when they are taken out and dried. The same process is repeated three times. Nets that have undergone this operation are supposed to last thrice as long as they would do without it.

Herrings die almost the moment after they are taken out of the water; whence originated the adage in common use, *as dead as a Herring*. They also become very soon tainted after they are killed. In summer they are sensibly worse for being out of the water only a few hours: and if exposed but a few minutes to the rays of the ſun, they are perfectly useless, and will not take the salt.

When the fishermen on the Scotch coast have plenty of salt, Herrings sell for about six shillings a barrel. As their salt is expended the price falls to five, four, three, two, and one shilling per barrel, sometimes even to six-pence or eight-pence; below which prices they will seldom shoot their nets, as a less price is not sufficient to indemnify them for the trouble in catching them. But it sometimes happens that a barrel of fine fresh Herrings may be purchased for a single chew of tobacco. A barrel contains from six hundred to sixteen hundred fish, according to their size*.

After the nets are hauled, the fish are thrown upon the deck of the vessel, and each of the crew has a certain task assigned to him. One part is employed in opening and gutting them; another in salting, and a third in packing them in the barrels in layers of salt. The red Herrings lie twenty-four hours in the brine; they are then taken out, strung by the head on little wooden spits, and hung in a chimney formed to receive them; after which a fire of brushwood, which yields much smoke, but no flame, is kindled under them, and they remain there till sufficiently smoked and dried; when they are put into barrels for carriage.

The Herrings are supposed to feed on a crustaceous sea insect called by Linnæus Oniscus marinus. They may be even caught with an artificial fly: an indication of their also sometimes seizing the winged insects.

THE PILCHARD†.

About the middle of July, the Pilchards, which are a smaller species of Herring, appear in vast shoals off the coasts of Cornwall, and about the latter end of September retire to the arctic regions. Forty years back Chriſtmas was the time of their departure; this alteration in time is a very singular fact*.

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* Anderson. † Clupea pilcardus. *Turton's Linn.*—*Penn. Brit. Zool. vol.* 3. *tab.* 68.

We have the following account of the fishery from Dr. Borlase :—" It employs (he says) a great number of men on the sea, training them thereby to naval affairs; employs men, women, and children, at land, in salting, pressing, washing, and cleaning; in making boats, nets, ropes, casks; and in all the trades depending on their construction, and sale. The poor are fed with the offals of the captures, the land with the refuse of the fish and salt; the merchant finds the gains of commission and honest commerce, the fisherman the gains of the fish. Ships are often freighted hither with salt, and into foreign countries with the fish, carrying off, at the same time, part of our tin. The usual produce of the number of hogsheads exported each year, for ten years, from 1747 to 1756 inclusive, from the four ports of Tawy, Falmouth, Penzance, and St. Ives, it appears, that Tawy has exported *yearly* 1732 hogsheads; Falmouth, 14,631 hogsheads and two-thirds; Penzance and Mounts-bay, 12,149 hogsheads and one-third; St. Ives, 1282 hogsheads: in all amounting to 29,795 hogsheads. Every hogshead, for ten years last past, together with the bounty allowed for each hogshead exported, and the oil made out of each hogshead, has amounted, one year with another, at an average, to the price of one pound thirteen shillings and three-pence; so that the cash paid for pilchards exported has, at a medium, annually amounted to the sum of 49,532l. 10s.*"

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* Maton's Observations on the Western Counties, vol. i. p. 140.

When Dr. Maton made the tour of the western counties, he and a friend hired a boat to go out and see the pilchard-fishing at Fowy near Looe, in Cornwall. He says that the fishing-boats, which are pretty numerous, are usually stationed in ten fathoms water, and clear of all breakers. Light sail-boats keep out at a little distance before them, to give notice to the fishermen of the approach of a shoal. Persons are also frequently stationed on the neighbouring rocks to watch the course of the fish: these are called *buers*, from the circumstance of their setting up a *bue* to the fishermen.

The nets, which are seines, are sometimes two hundred fathoms or more in circumference, and about eighteen deep. Some of them are said to hold upwards of two hundred hogsheads of fish, each containing about three thousand. About thirty thousand hogsheads are here looked upon as pretty good produce for one season. But it happens now and then that the fishery almost entirely fails. About ten years before Dr. Maton was at this place, the fishermen and their families had been compelled to live for some time solely on limpets and other shell-fish, which they cannot in any other circumstances be prevailed on to eat†.

The Dog-fish‡ are great enemies to the Pilchards, often devouring them in amazing numbers.

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* Borlase, 272.

† Maton, i. 140.

‡ Squalus catulus of Linnæus.

The chief difference between the Pilchard and the Herring is, that the body of the former is more round and thick; the nose shorter in proportion, turning up; and the under jaw shorter. The back is more elevated, and the belly not so sharp. The scales adhere very closely, whilst those of the Herring easily drop off. It is also in general of a considerably smaller size.

THE CARP TRIBE.

Most of the Carp tribe inhabit the fresh waters, where they feed on worms, insects, aquatic plants, fish, and clay or mould. Some of them are migratory. They have very small mouths and no teeth, and the gill-membrane has three rays. The body is smooth, and generally whitish. On the back is only one fin.

THE COMMON CARP*.

These fish are found in slow rivers and stagnant waters of Europe and Persia; and here principally in deep holes, under the roots of trees, hollow banks, or great beds of flags, &c. They do not often exceed four feet in length, and twenty pounds in weight; but Jovius mentions some taken in Italy that weighed two hundred pounds each.

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* Cyprinus carpio. *Lin.*—*Penn. Brit. Zool. vol. 3. tab. 70.*

Their form is somewhat thick, and their colour blue-green above, greenish-yellow mixed with black on the upper part of their sides, whitish beneath, and the tail yellow or violet. The scales are large. On each side of the mouth is a single beard, and above this another shorter. The dorsal fin is long, extending far towards the tail, which is forked.

Carp, from their quick growth and vast increase, (for the roe when taken out has frequently been found to weigh more than the fish,) are the most valuable of all fish for the stocking of ponds; and if the breeding and feeding of them were better understood, and more practised, the advantages resulting from them would be very great. A pond stocked with these fish would become as valuable to its owner as a garden. In many parts of Prussia Carp are bred in great quantities, and are thus made to form a considerable part of the revenue of the principal personages of the country, being sent from thence, in well-boats, into Sweden and Russia, where they are very scarce*.

By being constantly fed they may be rendered so familiar as always to come to the side of the pond where they are kept for food. Dr. Smith, speaking of the Prince of Condé's seat at Chantilly, says, "The most pleasing things about it were the immense shoals of very large Carp, silvered over with age, like silver fish, and perfectly tame, so that, when any passengers approached their watery habitation, they used to come to the shore in such numbers as to heave each other out of the water, begging for bread, of which a quantity was always kept at hand on purpose to feed them. They would even allow themselves to be handled*."

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* Albin on Esculent Fish, 7.

Carp are very long-lived; Gesner has mentioned an instance of one that was an hundred years old. They are also extremely tenacious of life, and will live for a great length of time out of water. An experiment has been made by placing a Carp in a net, well wrapped up in wet moss, (the mouth only remaining out,) and then hanging it up in a cellar or some cool place: the fish in this situation is to be frequently fed with white bread and milk, and is besides to be often plunged in water. Carp thus managed have been known, not only to live above a fortnight, but to have grown exceedingly fat, and become far superior in taste to those immediately taken from the pond†.

In their general manners they exhibit so great a degree of cunning as to be sometimes called by the country people, River Fox. When attempted to be taken by a net they will often leap over it, or immerse themselves so deep in the mud as to suffer the net to pass over without touching them. They are also very shy of taking a bait; but during spawning-time, so intent are they on the business of depositing their ova, that they will suffer themselves to be handled by any one that attempts it. They breed three or four times in the year, but their first spawning is in the beginning of May*.

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* Sketch of a Tour to the Continent.

† Penn. Brit. Zool. iii. 355.

These fish were first introduced into this country about three hundred years ago. Of their sound or air-bladder a kind of fish glue is made; and a green paint of their gall.

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* Walton, 160.—Penn. Brit. Zool. iii. 356.

CHONDROPTERYGIOUS FISH*.

THE STURGEONS.

THE fishes of this tribe are all inhabitants of the sea, though some of them occasionally go up the wider rivers. All the species are large, seldom measuring, when full grown, less than three or four feet in length. The flesh of the whole is reckoned extremely delicious; and to the inhabitants on the banks of the Caspian Sea, and indeed of many other parts both of Europe and America, these fish are very useful as an article of commerce. Their usual food is worms and other fish.

The head is obtuse; and the mouth, which is placed quite under the head, is tubular, and without teeth. Between the end of the snout and the mouth are four cirrhi, or tendrils; and on each side is a narrow aperture of the gills. The body is long in proportion to its thickness, and usually angular from several rows of large bony plates.

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* This is the sixth Linnean order of fishes.

THE COMMON STURGEON*.

The body of this fish, which is often found from six to sixteen feet in length, is pentagonal, being armed from head to tail with five rows of large bony tubercles, each of which ends in a strong recurved tip: one of these is on the back, one on each side, and two on the margin of the belly. The snout is long, and obtuse at the end, and has the tendrils near the tip. The mouth, which is beneath the head, is somewhat like the opening of a purse, and is so formed as to be pushed suddenly out or retracted. The upper part of the body is of a dirty olive colour; the lower part silvery; and the tubercles are white in the middle. Sturgeons are found both in the European and American seas.

The tendrils on the snout, which are some inches in length, have so great a resemblance in form to earth-worms, that at first sight they might be mistaken for them. This clumsy toothless fish is supposed by this contrivance to keep himself in good condition, the solidity of his flesh evidently showing him to be a fish of prey. He is said to hide his large body among the weeds near the sea-coast, or at the mouths of large rivers, only exposing his tendrils, which small fish or sea-insects, mistaking for real worms, approach for plunder, and are sucked into the jaws of their enemy. He has been supposed by some to root into the soil at the bottom of the sea or rivers; but the tendrils above mentioned, which hang from his snout over his mouth, must themselves be very inconvenient for this purpose; and as he has no jaws he evidently lives by suction, and during his residence in the sea marine insects are generally found in his stomach*.

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* Accipenser strurio. *Linn.*——*Penn. Brit. Zool. vol.* 3. *tab.* 19.

At the approach of spring, Sturgeons leave the deep recesses of the sea and enter the rivers to spawn; and from May to July the American rivers abound with them. Here they are often observed to leap to the height of several yards out of the water, which they do in an erect position, falling back again on their sides with such noise as to be heard in the still evenings to a great distance. They have often been known at these times to fall into the small boats or canoes of the Indians, and sink them. On this account it is often dangerous to pass the places that are much frequented by them, many instances having occurred of people losing their lives by this means. Some of the Indians take advantage of this propensity to leaping to catch them, by stationing themselves in pretty large boats in the places where they are seen, and receiving them as they fall†.

In some rivers of Virginia the Sturgeons are found in such numbers, that six hundred have been taken in two days, with no more trouble than putting down a pole with a hook at the end, to the bottom, and drawing it up again, on feeling it rub against a fish‡. They are, however, chiefly killed in the night with harpoons, attracted by the light of torches made of the wood of the black pine. On the shores are often seen the bodies of Sturgeons that have been wounded with the spears, and have afterwards died.

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* Note to Darwin's Botanic Garden.

† Catesby, vol. ii. p. xxxiii.   ‡ Burnaby, 15.

The Indians often fish for them in the lakes in the day-time: for this purpose there are usually two men to a canoe, one at the stern to work it forward, and the other at the head, with a pointed spear about fourteen feet long, tied to a long cord that is fastened to one of the cross timbers of the canoe. The moment a Sturgeon is seen within reach, the man at the head darts his spear into the tenderest part of the body that he can reach; and, if it penetrates, the fish swims off with astonishing velocity, dragging the canoe along the water after it. If, however, the blow has been pretty well aimed, the fish does not go more than two or three hundred yards before he dies; when the men draw up the line and take him*. Sometimes when Sturgeons are seen to lie at the bottom of the still water near the cataracts, they are struck with a spear without a rope, their place being marked on their rising by the appearance of the shaft above the water†.

The Sturgeon annually ascends our rivers, in the summer, particularly those of the Eden and Esk, but in no great numbers. It is so spiritless a fish, that, when taken by accident, as it sometimes is, in the Salmon nets, it scarcely makes any resistance, but is drawn out of the water apparently lifeless.

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* Charlevoix, i. 236.

† Catesby.

One of the largest ever caught in our rivers was taken in the Esk about twenty-six years ago; it weighed four hundred and sixty pounds*.

The flesh of the Sturgeon is well known to be extremely delicious; and it was so much valued in the time of the Emperor Severus, that it was brought to table by servants with coronets on their heads and preceded by music; which might give rise to its being in our country presented by the Lord Mayor to the King. At present the Sturgeons are caught in the Danube, the Volga, the Don, and other large rivers, for various purposes. The skin makes a good covering for carriages; caviar is prepared from the spawn; and the flesh is pickled or salted, and sent all over Europe†.

To make the caviar, the spawn is freed from the little fibres by which it is connected, washed in white wine or vinegar, and afterwards ſpread out to dry. It is then put into a vessel and salted, crushing it down with the hands; and afterwards inclosed in a canvas bag to drain off the moisture. It is last of all put into a tub with a hole in the bottom, that any remaining moisture may run off, pressed down, and closed for use.

It has been said that of the skin of the Sturgeon isinglass is made: but this is a mistake; for the Sturgeon is altogether of so cartilaginous a nature, that no part of it will produce isinglass except the inner coat of the air-bladder. The isinglass most common in our shops is made from a species of Dolphin called the Beluga‡.

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* Penn. Brit. Zool. iii. 126. † Note to Darwin's Botanic Garden.

‡ Delphinus leucas of Linnæus.

The bones are reported to be so hard as to serve the American Indians for rasps and nutmeg-graters*.

Their fecundity is exceedingly great: Catesby says that the females contain frequently a bushel of spawn each, and Leeuwenhoek found in the roe of one of them no fewer than 150,000,000,000 eggs.

THE SHARK TRIBE.

The animals that compose this dreadfully rapacious tribe are entirely marine, and more frequent in the hot than the temperate climates. They are in general solitary, and often wander to vast distances, devouring almost every thing that comes in their way, that they are able to swallow. Some of them will follow vessels several hundred leagues, for the carcases and filth that are thrown overboard. The size to which they grow is enormous, as they often weigh from one to four thousand pounds each. Some few species are gregarious, and live on the molluscæ and other marine worms. They are all viviparous, their young, when first protruded, being inclosed (alive) in a square pellucid, horny case, terminated at the four corners by very long, slender filaments, which are generally found twisted round corallines, sea-weed, and other fixed substances.

Their flesh is altogether so tough, coarse, and of such a disagreeable smell, that even the young are scarcely eatable. Their bodies emit a phosphoric light in the dark. The skin is rough, and is in general use for polishing ivory, wood and other substances; thongs and carriage traces are also sometimes made of it. The liver is generally found to yield a considerable quantity of oil. There are upwards of thirty species, of which eleven are found in the British seas.

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* Brickell, 237.

The body is compressed, long in proportion to the thickness, and tapers towards the tail. The head is obtuse, and on the side of the neck are from four to seven breathing apertures. The mouth, which is situated in the under part of the head, is armed with several rows of serrated, sharp-pointed teeth of different forms, some of which are fixed, and others moveable. The skin is covered with very slender prickles; and the upper part of the tail is generally longer than the lower.

THE WHITE SHARK*.

This Shark has six rows of teeth, hard, sharply-pointed, and of a wedge-like figure. These he has the power of erecting and depressing at pleasure. When at rest, they are quite flat in his mouth; but when his prey is to be seized, they are instantly erected by a set of muscles that join them to the jaw. Thus with open jaws, goggling eyes, and large and bristly fins, agitated like the mane of a lion, his whole aspect is an emphatical picture of the fiercest, deepest, and most savage malignity.

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* Squalus carcharias. *Linn.*

It is a fortunate circumstance for those who would avoid its attacks, that its mouth is so situated under the head, that it has to throw itself on one side in order to seize its prey; for its velocity in the water is so great, that nothing which it was once in pursuit of would otherwise be able to escape its voracity.

These creatures are the dread of sailors in all the hot climates, where they constantly attend the ships in expectation of what may drop overboard; and if in this case any of the men have that misfortune, they must inevitably perish.

Increasing still the terrors of the storms,
His jaws horrific arm'd with threefold fate,
Here dwells the direful Shark. Lured by the scent
Of steaming crowds, of rank disease, and death,
Behold! he rushing cuts the briny flood,
Swift as the gale can bear the ship along;
And, from the partners of that cruel trade
Which spoils unhappy Guinea of her sons,
Demands his share of prey, demands themselves.
The stormy fates descend: one death involves
Tyrants and slaves; when strait their mangled limbs
Crashing at once, he dyes the purple seas
With gore, and riots in the vengeful meal.

A master of a Guinea ship informed Mr. Pen nant that a rage for suicide prevailed among h slaves, from a notion of the unfortunate wretche that after death they should be restored to their f milies, friends, and country. To convince the that their bodies could never be re-animated, he o dered the corpse of one that was just dead to be tied by the heels to a rope, and lowered into the sea. It was drawn up again as quickly as the united force of the crew could do it; yet in that very short time the Sharks had devoured every part but the feet, which were secured by the end of the cord*.

Persons while swimming have often been seized and devoured by the Sharks. A gentleman now living, and well known, in this country, was some years ago swimming at a little distance from a ship, when he saw a Shark making towards him. Struck with terror at its approach, he immediately cried out for assistance. A rope was instantly thrown; and even while the men were in the act of drawing him up the ship's side, the monster darted after him, and, at a single snap, tore off his leg.

In the pearl-fisheries of South America every negro, to defend himself against these animals, carries with him into the water, a sharp knife, which, if the fish offers to assault him, he endeavours to strike into its belly; on which it generally swims off. The officers who are in the vessels keep a watchful eye on these voracious creatures, and, on discovering them, shake the ropes fastened to the negroes to put them on their guard. Many, when the divers have been in danger, have thrown themselves into the water, with knives in their hands, and hastened to their defence: but too often all their dexterity and precaution have been of no avail.

We are told that in the reign of queen Anne a merchant ship arrived at Barbadoes from England, some of the men of which were one day bathing in the sea, when a large Shark appeared and sprung forwards directly at them. A person from the ship called out to warn them of their danger; on which they all immediately swam to the vessel and arrived in perfect safety, except one poor fellow who was cut in two by the Shark almost within reach of the oars. A comrade and most intimate friend of the unfortunate victim, when he observed the severed trunk of his companion, was seized with a degree of horror that words cannot describe. The insatiable Shark was seen traversing the bloody surface in search of the remainder of his prey, when the brave youth plunged into the water,[*] determining either to make the Shark disgorge, or to be buried himself in the same grave. He held in his hand a long and sharp-pointed knife, and the rapacious animal pushed furiously towards him: he had turned on his side, and opened his enormous jaws, in order to seize him, when the youth diving dexterously under seized him with his left hand somewhere below the upper fins, and stabbed him several times in the belly. The Shark, enraged with pain and streaming with blood, plunged in all directions in order to disengage himself from his enemy. The crews of the surrounding vessels saw that the combat was decided; but they were ignorant which was slain, till the Shark, weakened at length by loss of blood, made towards the shore, and along with him his conqueror; who, flushed with victory, pushed his foe with redoubled ardour, and with the aid of an ebbing tide dragged him on shore. Here he ripped up the bowels of the animal, obtained the severed remainder of his friend's body, and buried it with the trunk in the same grave.

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* Penn. Brit. Zool. iii. 106.

This story, however incredible it may appear, is related in the history of Barbadoes, on the most satisfactory authority*.

The West Indian negroes often venture to contend with the Shark in close combat. They know his power to be limited by the position of his mouth underneath: and as soon as they discover him, they dive beneath, and, in rising, stab him before he has an opportunity of putting himself into a state of defence. Thus do boldness and address unite in triumph over strength and ferocity†.

The South Sea islanders are not in the least afraid of the Sharks, but will swim among them without exhibiting the least signs of fear. "I have seen," says captain Portlock, "five or six large Sharks swimming about the ship, when there have been upwards of a hundred Indians in the water, both men and women: they seemed quite indifferent about them, and the Sharks never offered to make an attack on any of them, and yet at the same time would seize our bait greedily; whence it is manifest that they derive their confidence of safety from their experience that they are able to repel the attacks of those devouring monsters ‡."

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* Hughes's Natural History of Barbadoes.

† Marchand, i. *93*. ‡ Portlock's Voyage, 300.

An Indian on the coast of California, on plunging into the sea, was seized by a Shark; but, by a most extraordinary feat of activity, cleared himself, and, though considerably wounded, threw blood and water at the animal to show his bravery and contempt. But the voracious monster seized him with horrid violence a second time, and in a moment dragged him to the bottom. His companions, though not far from him, and much affected by the loss, were not able to render him any assistance whatever*.

We are told that, notwithstanding the voracity of these creatures, they will not devour any feathered animal that is thrown overboard; but that they will readily take a bait of a piece of flesh fastened on an iron crook. They are so tenacious of life as to move about long after their head is cut off†.

Their flesh is sometimes eaten by sailors on long voyages; and though exceedingly coarse and rank, it is generally thought better than that of any others of the genus. The skin is rough, hard, and prickly, and, when properly manufactured, is used in covering instrument cases, under the name of *shagreen.*

THE BASKING SHARK‡.

This species has derived its name from its propensity to lie on the surface of the water, as if to bask itself in the sun. It possesses, (though a very large fish,) none of the voracity and ferociousness that mark the generality of the Shark tribe. It will frequently lie motionless on the surface of the water, generally on its belly, but sometimes on its back; and it seems so little afraid of mankind, as often to suffer itself to be patted and stroked.

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* Venegas, ii. 115.

† St. Pierre's Voyage to the Isle of France, 28.

‡ Squalus maximus. *Linn.*——*Penn. Brit. Zool. vol. 3. tab.* 13.

Its body is slender, and from three to twelve yards in length, of a deep lead colour above, and white below. The upper jaw is blunt at the end, and much longer than the lower. The mouth is placed beneath, and furnished with small teeth, those before much bent, and the remote ones conical and sharp-pointed. On each side of the neck are five breathing apertures. There are two dorsal, two pectoral, two ventral fins, and one small anal fin. Within the mouth, near the throat, is a short kind of whalebone.

The Basking Sharks frequent our seas during the warm summer months, and are not uncommon on the Welsh and Scottish coasts, coming in shoals usually after intervals of a certain number of years. In the intervening summers those that are seen on the Welsh coast are generally single fish, that have probably strayed from the rest. They appear in the Firth of Clyde and among the Hebrides about midsummer, in small droves of seven or eight, or more commonly in pairs. Here they continue till the latter end of July, when they disappear.

Their food seems to consist entirely of marine plants and some of the species of Medusæ. They swim very deliberately, and generally with their upper fins above water. Sometimes they may be seen sporting about among the waves, and leaping several feet above the surface.

The liver is of such immense size as frequently to weigh near a thousand pounds. From this a great quantity of good oil is extracted; which renders this Shark an animal of considerable importance to the Scotch fishermen: for, according to Anderson, the oil of a single fish will sometimes sell for twenty or thirty pounds sterling.

The natives of our northern coasts are very alert in the pursuit, and very dexterous in the killing of these fish. When pursued, they do not accelerate their motion till the boat comes almost in contact with them, when the harpooner strikes his weapon into the body as near the gills as he can. They seem not very susceptible of pain; for they often remain in the same place till the united strength of two men is exerted to force the harpoon deeper. As soon as they perceive themselves wounded they plunge headlong to the bottom; and frequently coil the rope round their bodies in agony, attempting to disengage themselves from the fatal instrument by rolling on the ground. Discovering that these efforts are in vain, they swim off with such amazing rapidity that one instance has occurred of a Basking Shark towing to some distance a vessel of seventy tons burthen, against a fresh gale. They sometimes run off with two hundred fathoms of line, and two harpoons in them; and will employ the men from twelve to twenty-four hours before they are subdued.

As soon as they are killed the fishermen hawl them on shore, or, if at a distance from land, to the vessel's side, to cut them up and take out the liver, which is the only useful part of their bodies. This is melted into oil in kettles provided for the purpose; and, if the fish is a large one, it will yield eight barrels or upwards.

THE RAY TRIBE.

The Rays are entirely confined to the sea; and from being destitute of an air-bladder to buoy them, they live altogether at the bottom, chiefly in deep water, covering themselves in winter in sand or mud. They live on shell-fish, or any animal substances whatever that come in their way. Some of them become of a size so large as to weigh two hundred pounds and upwards; in which case they are sometimes dangerous enemies to man, whom they are said to destroy by getting him down, lying upon, and devouring him. They seldom produce more than one young at a time, which, as in the Sharks, is enclosed in a four-cornered bag or shell, ending in slender points; but not, (as in those) extending into long filaments.

In their fresh state, most of the species have a fetid and unpleasant smell, but nearly the whole are eatable. There are about *twenty* species. Those with which we are best acquainted are the Skate, the Thornback, and the Torpedo or Electric Ray.

Their bodies are broad, thin, and flat. The mouth is situated beneath, and the eyes above the body. The breathing apertures are five on each side, a little below the mouth. The head is in general small and pointed, and not distinct from the body.

The liver is large, and often produces a great quantity of oil.

THE ELECTRIC RAY*.

We have selected the Torpedo or Electric Ray from the rest of the genus, since no accounts of the other species have been preserved that are deserving of much attention; their general habits and manners being, as far as we know, nearly the same, and similar to what we have stated in the description of the genus.

The present species is, however, altogether so remarkable, as to merit very particular notice. It is found in many of the European seas, and the fishermen often discover it in Torbay; and sometimes of such a size as to weigh near eighty pounds.

The head and body are indistinct from each other, and nearly of a circular form, two or three inches thick in the middle, attenuating to extreme thinness on the edges. The skin is smooth, of a dusky brown above, and white underneath. The ventral fins form on each side, at the end of the body, nearly a quarter of a circle. The tail is short, and the two dorsal fins are placed near its origin. The mouth is small, and, as in the other species, there are on each side below it five breathing apertures.

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* SYNONYMS.—Raia Torpedo. *Linn.*—Torpedo, Cramp-fish. *Will. Ich.*—Electrical Ray. *Penn.*——*Penn. Brit. Zool.* vol. 3. *tab.* 10.

The Electric Rays are partial to sandy bottoms, in about forty fathoms of water, where they often bury themselves by flinging the sand over them by a quick flapping of all the extremities. In Torbay they are generally taken, like other flat-fish, with the trawl-net, and instances have occurred of their seizing a bait.

This fish possesses the same property of benumbing its prey, as that which we have before described in the Electric Eel; and when it is in health and vigour, the shock that it communicates is often very severe; but its powers always decline as the animal declines in strength, and when it expires they entirely cease. In winter these are also much less formidable than during warm weather.

Dr. Ingenhouz had a Torpedo for some time in a tub of sea-water, which, (from its being during winter,) seemed to be feeble. On taking it into his hands, and pressing it on each side of the head, a sudden tremor, which lasted for two or three seconds, passed into his fingers, but extended no further. After a few seconds the same trembling was felt again; and again several times, after different intervals. The sensation was, he says, the same that he should have felt by the discharge of several very small electrical bottles, one after another, into his hand. The shocks sometimes followed each other very quickly, and increased in strength towards the last. Probably from the weakness of the fish, the shock could not be communicated through a brass chain, though the usual contortion was evidently made. A coated vial was applied to it, but could not be charged *.

From some experiments that were made by Mr. Walsh on a very stout and healthy fish, it appears, that although it seemed to possess many electric properties, yet no spark whatever could be discovered to proceed from it, nor were pith-balls ever found to be affected by it. When it was insulated it gave a shock to persons likewise insulated, and even to several that took hold of each others hands: this it did forty or fifty times successively, and with very little diminution of force. If touched only with one finger, the shock was so great as to be felt in both hands. Each effort was accompanied by a depression of the eyes, which plainly indicated the attempts that were made upon non-conductors. Although the animal was in full vigour, it was not able to force the torpedinal fluid across the minutest tract of air, not even from one link of a small chain freely suspended to another, nor through an almost invisible separation made by a penknife in a slip of tinfoil pasted on sealing-wax †.

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* Phil. Tran. vol. lxv. p. 1.

† Walsh in Phil. Tran. vol. lxiii. p. 461.

The properties of this fish have been described by Oppian; but, with that liberty which poets always think themselves entitled to, he has endowed it with the power of benumbing the fisherman through the whole length of his line and rod.

> The hook'd Torpedo ne'er forgets his art,
> But soon as struck begins to play its part;
> And to the line applies his magic sides:
> Without delay the subtile power glides
> Along the pliant rod and slender hairs,
> Then to the fisher's hand as swift repairs:
> Amaz'd he stands, his arms of sense bereft,
> Down drops the idle rod, his prey is left:
> Not less benumbed than had he felt the whole
> Of frost's severest rage beneath the Arctic pole[*].

In the general structure of its body the Torpedo has not been found to differ materially from the rest of the Rays. The electric organs are placed one on each side of the cranium and gills, reaching from thence to the semicircular cartilages of each great fin, and extending longitudinally from the anterior extremity of the animal to the transverse cartilage which divides the thorax from the abdomen: and within these limits they occupy the whole space between the skin of the upper and under surfaces. Each organ is attached to the surrounding parts by a close cellular membrane, and also by short and strong tendinous fibres, which pass directly across from its outer edge to the semicircular cartilages.

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[*] Jones's translation of Oppian.

They are covered above and below with the common skin of the animal, under which are longitudinal fibres spread entirely over them. Each organ is about five inches in length, and at the anterior end about three in breadth. They are composed of perpendicular columns, reaching from the upper to the under surface, varying in length, according to the thickness of the parts of the body, from an inch and a half to half an inch; and their diameters are from a fourth to a fifth of an inch.

The coats of the columns are very thin, and almost transparent. The number of columns in each organ varies considerably in different animals. That of one that Mr. Hunter presented to the Royal Society was about 470; but in a very large Torpedo the number of columns in one organ was 1182. These columns were composed of films parallel to the base of each, and the distance between each of the columns was 150th part of an inch. If we suppose these films to be charged with electricity, and to be the 300th of an inch thick; and a middling-sized Torpedo to contain in both organs, on the whole, 1000 columns each an inch long, and 0.03 square inches area at the base; then 1000 × 150 × 0.03 = 4500 square inches. Now it has been clearly proved that the capacity of stout glass is thirty-six times less than that of these organs; therefore both the organs of a middling-sized Torpedo will be equivalent to 4500 × 36 = 162,000 square inches, or 1125 square feet of glass.—The nerves inserted into each organ arise by three very large trunks from the lateral and posterior part of the brain. These, having entered the organs, ramify in every direction between the columns. Their number and magnitude are extremely great, and it is supposed that they are subservient to the formation, collection, and management of the torpedinal fluid*.

The Torpedo brings forth its young in the autumn.

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* Hunter in Phil. Tran. vol. lxvii. p. 481.—Nicholson's Philosophical Journal.

INSECTS.

Each moss,
Each shell, each crawling insect, holds a rank
Important in the plan of Him who fram'd
This scale of beings; holds a rank, which lost
Would break the chain, and leave a gap
That nature's self would rue!

THE Insect division of the animal world has its name from the individuals of which it is composed having a separation in the middle of their bodies, by which they are cut into two parts: these parts are in general connected by a slender ligament or hollow thread.

Insects breathe through pores arranged along their sides*; and have a hard or bony skin, and many feet. They are destitute of brain, nostrils, ears, and eye-lids. The mouth is in general under the head, and furnished with transverse jaws, lips, teeth, a tongue, and a palate: it has also in general four or six *palpi* or feelers which to insects serve in place of hands, to convey food, and hold it to the mouth while eating. They have also moveable antennæ proceeding from the head, which are endowed with a very nice sense of feeling.

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* The Crab and Lobster tribes form an exception to this rule, for they respire by means of *tracheæ* or gills.

In a minute examination that has lately been made in this class by Cuvier, one of the most accurate observers of nature now living, he has not been able to detect in any of them either a heart or arteries; and he says that the whole organization of insects is such as one would expect to find, if they had been actually known not to be provided with such organs. Their nutrition, therefore, would seem to be carried on by immediate absorption, as is evidently the case with the polypes, and other zoophytes, which are considerably below insects in the perfection of their organization *.

Nearly all insects (except Spiders, and a few others of the apterous tribe, which proceed in a perfect state from the egg) undergo a METAMORPHOSIS or change at three different periods of their existence.

The eggs are invariably deposited in such places as, when the worms are produced, to afford them proper food. From the egg proceeds the *larva* (grub or caterpillar): this has in general many feet, and is extremely voracious. In the larva state the insects grow, and change their skin. From this state they change into a *pupa* or chrysalis, becoming to appearance perfectly lifeless for some time. They are now either naked, or covered with a kind of web, and are called Aurelia, Bean, Cod, Cone, or Nymph. Escaping from this second, they appear last of all in their third, or *perfect* state. Now it is that they are those active little creatures that we observe fluttering on every side of us, and enlivening all our summer scenes with their presence: and in this state it is that they lay their eggs.

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* He excepts the Crabs and Lobsters, which he arranges in a class by themselves, and denominates Crustaceous animals.

Some writers have conjectured that the *antennæ* or horns of insects were their organs of hearing; for it is evident from various experiments, that insects are possessed of this sense in a degree as exquisite as most other animals, although from their minuteness we may never discover by what means. The antennæ, however, seem little likely to answer the purpose of ears. These instruments of apparently exquisite sensibility seem adapted to very different purposes, but to purposes with which we may remain long unacquainted.

The *eyes* are formed of a transparent crustaceous set of lenses, so sufficiently hard as to require no coverings to protect them. These, like multiplying glasses, have innumerable surfaces, on every one of which the objects are distinctly formed; so that, if a candle is held opposite to them, it appears multiplied almost to infinity on their surfaces. Other creatures are obliged to turn their eyes; but insects have always some or other of these lenses directed towards objects, from what quarter soever they present themselves. All these minute hemispheres are real eyes, through which every thing appears topsyturvy.

Mr. Leeuwenhoek looked through the eye of an insect (with the help of a microscope) as a telescope; and viewed the steeple of a church, which was 299 feet high, and 750 from the place; he could plainly see the steeple, though not apparently larger than the point of a fine needle. He also viewed a house; and could discern the front, distinguish the doors and windows, and perceive whether the windows were open or shut. Mr. Hook computed 14,000 hemispheres in the two eyes of a drone. Mr. Leeuwenhoek reckons in each eye of the dragon fly 12,544 lenses: the pictures of objects therefore that are delineated on these must be millions of times less than those formed on the human eye. Many insects still smaller have eyes, no doubt, contrived so as to discern objects some thousands of times less than themselves, for such the minute particles on which they feed must certainly be. How astonishing, therefore, must be the magnifying power of such eyes! And what extraordinary discoveries might be made, were it possible to obtain glasses through which we could see as they do!

With respect to the *wings* of insects, the two first orders of Linnæus have theirs defended by a pair of crustaceous cases called elytra. The three subsequent orders have four membranaceous wings, without elytra. All the insects of the sixth order have but two wings, and under each of these, at its base, is a poise or balance like a little knob. These poises are commonly little balls, placed on the top of a slender stalk, and moveable every way at pleasure. In some they stand alone, but in others, as in the whole Flesh-fly tribe, they have little covers or shields under which they lie and move. The use of these to the insect seems very clearly to be the same as a long pole, loaded at each end with lead, is to a rope-dancer: they render the body steady, and obviate all it's vacillations in flight. If one of them be cut off, the insect will immediately fly ill, one side evidently overbalancing the other, till it falls to the ground: if both be cut off, it will fly very awkwardly and unsteadily, manifesting a defect of some necessary part.

The structure of the *legs* and *feet* of these little creatures is truly admirable. Some are furnished with sharp hooked claws, and skinny palms, as some flies, by which, from the pressure of the atmosphere, they are enabled to walk on glass and other smooth surfaces even with their backs downwards. Others have somewhat like spunges that answer the same purposes. The Spider has each foot armed with a comb; probably to secure the six threads that issue from so many orifices from tangling.

The *tongue* in the Butterfly-tribe is spiral and curved like the spring of a watch: that of the Gnat and some of the flies is short, pointed, and hollow, and through its tubular interior these insects are enabled to draw their nourishment.

The mouths of most insects are defended by bristles which tend to keep out every thing injurious.

There are seven Linnæan orders of insects; namely, Coleopterous, Hemipterous, Lepidopterous

Neuropterous, Hymenopterous, Dipterous and Apterous insects *.

1. *Coleopterous insects* (derived from the Greek words κολεος a sheath, and πτερον a wing,) are such as have crustaceous elytra or shells, which shut together and form a longitudinal suture down the back. Of this order are the Beetle tribe and several others.

2. *Hemipterous insects* (from ἡμισυς half, and πτερον a wing) have their upper wings half crustaceous, and half membranaceous, not divided by a longitudinal suture, but incumbent on or crossed over each other; as the Cock-roach, Locust, &c.

3. *Lepidopterous insects* (from λεπις a scale, and πτερον a wing) are those having four wings covered with fine scales in the form of powder or meal; as in the Butterflies and Moths.

4. *Neuropterous insects* (from νευρον a nerve, and πτερον a wing) have four membranaceous, transparent, naked wings, in which the membranes cross each other so as to appear like net-work. The tail has no sting, but is frequently furnished with appendices like pincers, by which the males are distinguished. The common Dragon-fly is the best example that can be brought to illustrate this order.

5. *Hymenopterous insects* (from ὑμην a membrane, and πτερον a wing). The insects belonging to this order have generally four membranaceous naked wings; the neuters however in some of the genera, and in others the males or females, want wings. The

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* Coleoptera, Hemiptera, Lepidoptera, Neuroptera, Hymenoptera, Diptera and Aptera.

wings are not so much like net-work as those of the last order. The tail, except in the male, is armed with a sting. The Bee, the Wasp and the Ant are of this tribe.

6. *Dipterous insects* (from διπλοος double, and πτερον a wing) are those having only two wings, each furnished at its base with a poise or balancer. The common House-flies and the Gnat are familiar examples of this order.

7. *Apterous insects* (from α without, and πτερον a wing). This order contains all such insects as want wings in both sexes; as the Spider, Flea, and Louse.

INSECTS.

THE BEETLE TRIBE*.

THE antennæ of the Beetles have a clavate or enlarged extremity, which is divided into lamellæ or leaves. At the mouth are four feelers. The feet have five joints; and the shanks of the fore-legs are generally toothed.

The larvæ or grubs have six feet: in their general external appearance they are not much unlike the caterpillars of some of the butterflies, having their bodies composed of rings, and being somewhat hairy. Most of them live entirely under the surface of the ground, feeding on the roots of plants, &c. Their *chrysalis* generally lies dormant in the earth till the perfect insect bursts out.

Beetles inhabit and feed in various situations; some are found in the dung of cattle; others in rotten and half-decayed wood, under the decayed bark of trees, on the carcases of putrid animals, or on fetid plants or fungi: some in rivers, lakes, or stagnant pools; in damp cellars, subterraneous passages, or under the surface of the ground. Several in the sunny days are to be seen on plants and flowers. Multitudes live under stones, moss and rubbish. They are, in short, to be met with in almost every possible situation; and their numbers are immensely great.

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* The Linnean order of COLEOPTEROUS INSECTS commences with this tribe.

THE COCK-CHAFER *.

The larvæ or grubs of this species of Beetle so well known in England by the name of Cock-chafer, are more voracious, and more destructive to vegetation, than those of almost any of the insect tribes.

The eggs are deposited in the ground by the winged insect, whose fore-legs are very short, and well calculated for burrowing. From each of these proceeds, after a short time, a whitish worm with six legs, a red head and strong claws, and about an inch and a half long, which is destined to live in the earth under that form for four years, and there undergo various changes of its skin, until it assumes its pupa form. It subsists, during its subterraneous abode, on the roots of trees and plants, committing ravages often of the most deplorable nature. These creatures, sometimes in immense numbers, work

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* SYNONYMS.—Scarabæus Melolontha. *Linn.*—Brown Tree Beetle, Blind Beetle, Chafer, Cock-chafer, Jack-horner, Jeffry-cock, May bug, Tree Bee.le, Blind Beetle, Brown Clock, Dor, in various parts of England. Millers, from their powdery white colour—The Grub is called the Connaught worm in Ireland.

between the turf and the ſoil in the richeſt meadows, devouring the roots of the graſs to that degree, that the turf rises and will roll up with almost as much ease as if it had been cut with a turfing-spade: and underneath, the soil appears turned into a soft mould for about an inch in depth, like the bed of a garden. In this the grubs lie, in a curved position, on their backs, the head and tail uppermost, and the rest of the body buried in the mould. Mr. Arderon of Norwich mentions his having seen a whole field of fine flourishing grass in the summer time, become in a few weeks withered, dry, and as brittle as hay, by these grubs devouring the roots, and gnawing away all those fibres that fastened it to the ground, and through which alone it could receive nourishment *.

The larvæ, as we have said, continue four years in the ground; and when at the end of this period they are about to undergo their change, they dig deep into the earth, sometimes five or six feet, and there spin a smooth case, in which they change into the pupa or chrysalis. The pupa remains under this form all winter till the month of February, when it becomes a perfect beetle, soft and white. In May the parts become hardened, and it then comes out of the earth: this accounts for our often finding the perfect insects in the ground.

Cock-chafers fly in the evening towards sun-set, and particularly about places where there are trees. They eat the leaves of the sycamore, the lime, the beech, the willow, and those of all kinds of fruit-trees.

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* Phil. Tran. vol. xliv. p. 579.

In its winged state this insect exhibits not less voracity on the leaves of trees, than it before did in its grub state, in the earth; for, such is the avidity with which it devours its food, and so immense are sometimes the numbers, as, in particular districts, to have rendered it an oppressive scourge that has produced much calamity among the people.

In the year 1688, the Cock-chafers appeared on the hedges and trees of the south-west coast of the county of Galway, in clusters of thousands, clinging to each other's backs in the manner of bees when they swarm. During the day they continued quiet, but towards sun-set the whole were in motion; and the humming noise of their wings sounded like distant drums. Their numbers were so great that for the space of two or three square miles they entirely darkened the air. Persons travelling on the roads, or who were abroad in the fields, found it difficult to make their way home, as the insects were continually beating against their faces, and caused great pain. In a very short time the leaves of all the trees for some miles round were destroyed, leaving the whole country, though it was near midsummer, as naked and desolate as it would have been in the middle of winter. The noise that these enormous swarms made in seizing and devouring the leaves, was so loud as to have been compared to the distant sawing of timber. Swine and poultry destroyed them in vast numbers: they waited under the trees for the clusters dropping, and devoured such swarms as to become fat from them alone; even the native Irish, from these having eaten up the whole of the produce of the ground, adopted a mode of dressing them, and used them as food. Towards the end of summer they disappeared so suddenly, that in a few days there was not a single one left *.

About sixty years ago a farm near Norwich was so infested, that the farmer and his servants affirmed that they gathered eighty bushels of them; and the grubs had done so much injury, that the court of that city, in compassion to the poor fellow's misfortune, allowed him 25 l.

Mouffet informs us, that in the month of February 1574 there were such multitudes of these insects in the western parts of England, that those which fell into the river Severn completely clogged the water-wheels of the mills †.

The rooks and gulls devour immense numbers of the grubs of this destructive insect, by which they render a most essential service to mankind, and great care ought to be taken to cherish and protect them. The sole employment of rooks, for nearly three months in the spring of the year, is to search for insects of this sort for food, and the havoc that a numerous flock makes among them must be very great.

A cautious observer having found a nest of five young jays, remarked that each of these birds, while yet very young, consumed at least fifteen of these full-sized grubs in a day; and averaging their sizes, it may be said that they each consumed

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* Phil. Tran. vol. xix. p. 741. † Ibid. vol. xliv.

twenty: this for the five makes a hundred: and if we suppose the two parents to devour between them the same number, it appears that this family consumed about two hundred every day. This in three months amounts to twenty thousand. But as the grub continues in the same state for four years, this single pair with their family alone, without reckoning their descendants after the first year, would destroy as many as eighty thousand grubs. Now, supposing that forty thousand of these may be females, and that each female lays, as is the case, about two hundred eggs, it will appear that no less than *eight millions* of grubs have been destroyed, or at least prevented from being hatched, by this single family of jays.

It is true, that in these labours of the rooks, jays, and some other birds, they sometimes do mischief to man; yet there can be little doubt that the damage they thus commit is amply repaid by the benefit that results from these their unceasing exertions.

Some farmers plough the ground in order to expose the grubs to the birds; and others take the pains to dig deep wherever the rooks point them out by their attempts to reach them.

In the winged state, to shake the trees at noon, when the insects are all either asleep or in a state of inactive stupor, and gather or sweep them up from the ground, seems the most eligible method. One person has been known to kill in a day, by this method, above a thousand; by which, though in so short a space of time, he, at a fair calculation, prevented no less than a hundred thousand eggs from being laid.

The dead bodies of these insects afford a most acceptable food to ducks, turkies, and other poultry. Swine, as we have observed before, will likewise greedily devour them, particularly when bruised and mixed with their other food*.

A person near Blois, in France, employed in the year 1785 a number of children and poor persons to destroy the Cock-chafers, at the rate of two liards a hundred. In a few days fourteen thousand were brought to him. Thus, for the moderate sum of about seven shillings and eightpence sterling, he destroyed, according to his calculation, near a *million and a half* of the grubs; which, had they been allowed to be hatched, might, in the course of four years, have done damage to the amount of many thousand pounds†.

THE ROSE-CHAFER‡.

We do not recollect that any of the English beetles are more beautiful than this. The upper parts of the female are of a shining green colour, varying according to the light in which it is held, and marked transversely on the wing cases with a few short white or yellowish lines. The male is of a burnished

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[*] It is however said, that when swine have once been fully satiated with them, they never care for them afterwards.

[†] Anderson's Recreations of Agriculture, iii. 420.

[‡] SYNONYMS.—Scarabæus auratus. *Linn.* Rose May Chafer, Green Beetle, and Brass Beetle, in some parts of England.

copper colour with a greenish cast. They grow to somewhat more than an inch in length, and are to be met with on flowers, particularly on those of the rose and peony.

The grubs that produce this beetle feed underground, most commonly at the roots of trees, and never appear on the surface unless disturbed by digging or some other accident. They are thought to be injurious to the gardener from their devouring the roots of his plants and trees. The female deposits her eggs in the middle of June: for this purpose she burrows into soft light ground, hollowing out and forming for them a proper receptacle. When the operation is over she returns to the surface, and flies off, but seldom lives more than two months afterwards. The grubs are produced in about fourteen days, and immediately seek out for food, which the parent always takes care shall be near the place where she lays her eggs. As soon as they have attained sufficient strength the young grubs separate, each burrowing a different way in search of roots. They remain four years in this state, annually changing their skin till they become of full growth, when they are of a cream colour, with brown head and feet. During winter they eat but little, if at all, and retire pretty deep into the ground to avoid the effects of the frost.

About the month of March, at the end of the fourth year, the grub forms a case of earth, about the size of a walnut, somewhere near the surface, within which it changes into a chrysalis. In this state it remains till the beginning of May, when it bursts out a perfect Chafer. This is at first of a light green colour, and very tender; but it soon acquires its hardness and strength, when it flies off to prey on the favourite food of the species.

When the insect is touched it emits a fetid moisture. This is, no doubt, a mode of defence against the attacks of its enemies*.

THE BURYING BEETLE†.

THIS insect is an inhabitant of the deserts of Tartary, and several other parts of the continent, where it is generally found under carcases that are dried in the sun. Its shells are of an opake black colour, striated, punctured, and somewhat rough.

The best account that we have of the manners of this interesting insect, is by M. Gleditch, a well known writer on natural history. This gentleman had at different times observed, that moles which had been left upon the ground after they had been killed, very unaccountably disappeared. He therefore was determined to ascertain by experiment, if possible, what could be the cause of this singular occurrence.

On the twenty-fifth of May, he accordingly obtained a dead mole, which he placed on the moist soft earth of his garden, and in two days he found it sunk to the depth of four fingers' breadth into the earth: it was in the same position in which he had placed it, and its grave corresponded exactly with the length and breadth of its body. The day following this grave was half filled up; and he drew out the mole cautiously, which exhaled a horrible stench, and found, directly under it, little holes in which were four beetles of the present species. Discovering at this time nothing but these beetles, he put them into the hollow, and they quickly hid themselves among the earth. He then replaced the mole as he found it, and having spread a little soft earth over it, left it without looking at it again for the space of six days. On the twelfth of June he again took up the same carcase, which he found in the highest state of corruption, swarming with small, thick, whitish worms, that appeared to be the family of the beetles. These circumstances induced him to suppose that it was the beetles that had thus buried the mole, and that they had done this for the sake of lodging in it their offspring.

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* Harris's Aurelian, 37.

† Scarabæus morticinii. *Linn.*

Mr. G. then took a glass cucurbit, and half filled it with moist earth, into this he put the four beetles with their young, and they immediately concealed themselves. This cucurbit, covered with a cloth, was placed on the open ground, and in the course of fifty days the four beetles interred the bodies of *four* frogs, *three* small birds, *two* grasshoppers, and *one* mole, besides the entrails of a fish, and two morsels of the lungs of an ox.

Of the mode in which they performed this very singular operation, the following is an account. A linnet that had been dead six hours was placed in the middle of the cucurbit; in a few moments the beetles quitted their holes and traversed the body. After a few hours, one pair of the beetles only was seen about the bird, the largest of which was suspected to be the female. They began their work in hollowing out the earth from under the bird. They arranged a cavity the size of the bird, by pushing all around the body the earth which they removed. To succeed in these efforts, they leaned themselves strongly upon their collars, and, bending down their heads, forced out the earth around the bird like a kind of rampart. The work being finished, and the bird having fallen into the hollow, they covered it, and thus closed the grave.

It appeared as if the bird moved alternately its head, its tail, its wings, or feet. Every time that any of these movements were observed, the efforts that the beetles made to draw the body into the grave, which was now nearly completed, might be remarked: in effecting this, they jointly drew it by its feathers below. This operation lasted full two hours, when the smallest or male beetle, drove away the female from the grave, and would not allow her to return, forcing her to enter the hole as often as she attempted to come out of it.

This beetle continued the work alone for at least five hours: and it was truly astonishing to observe the great quantity of earth that he removed in that time: but the surprise of Mr. G. was much augmented when he saw the little animal, stiffening its collar, and exerting all its strength, lift up the bird, make it change its place, turn, and in some measure arrange it in the grave that it had prepared; which was so spacious, and so far cleared, that he could perceive exactly under the bird all the movements and all the actions of the beetle.

From time to time the beetle, coming out of its hole, mounted upon the bird, and appeared to tread it down; then returning to the charge, it drew the bird more and more into the earth till it was sunk to a considerable depth. The beetle, in consequence of this uninterrupted labour, appeared to be tired; leaning its head upon the earth, it continued in that position near an hour, without motion; and it then retired completely under ground.

Early in the morning the body was drawn entirely under ground, to the depth of two fingers' breadth, in the same position that it had when laid on the earth; so that this little corpse seemed as if it were laid out on a bier, with a small mount or rampart all round, for the purpose of covering it. In the evening the bird was sunk about half a finger's breadth deeper into the earth; and the operation was continued for near two days more, when the work obtained its final completion.

A single beetle was put into the glass cucurbit with the body of a mole, and covered, as before, with a fine linen cloth. About seven o'clock in the morning, the bettle had drawn the head of the mole below; and, in pushing the earth backward, had formed a pretty high rampart around it. The interment was completed in this instance by four o'clock in the afternoon, a space of time so short, that one could scarcely have imagined possible by so small a creature, without any assistance, considering that the body of the mole must have exceeded it in bulk and weight at least thirty times.

While engaged in these experiments, a friend who wished to dry a toad in the shade, fixed it to a stick which he stuck into the ground. When it began to putrefy, the beetles, allured by the smell, having loosened the end of the stick that was fixed in the earth, brought it to the ground, and they then interred both the toad and the stick together.

The interment of these animals, which generally takes place from about the middle of April to the end of October, has been sufficiently proved to be not merely for food, but as a proper nidus for the eggs of the animals, and to nourish the young family of worms that proceeds from them. If they wanted them for food only, they would no doubt consume them above ground, but, in the continuation of the species it is necessary to have them below, since otherwise foxes, ravens, kites, and other carnivorous animals, would seize on the bodies, and along with them would swallow the larvæ of the beetles, and the whole species would thus be under the risk of extirpation.

THE DUNG BEETLE*.

The Dung Beetle is somewhat more than an inch in length, and of a dusky black colour, sometimes with a greenish hue, above, and underneath of a very brilliant blue or green. The wing cases and thorax are very smooth, the former marked with several longitudinal streaks, and the latter round, and margined, having a slight groove in the middle.

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* Synonyms—Scarabæus pilularius. *Linn.*—Tumble-dung Beetle. *Brickell*,

It is found both in Europe and America, and in its manners is one of the most remarkable of the beetle tribe. It comes forth in April, and is to be seen till about September, when it disappears. Its almost constant employment, in which indeed it is indefatigable, is in the different operations necessary to continue its species. It provides a proper nidus for its eggs by forming rouhd pellets of dung, in the middle of each of which it deposits an egg. These, in September, the insects convey to the depth of about three feet in the earth, where they remain till the approach of spring, when the grubs burst their shell, and find their way to the surface of the earth.

"I have attentively admired their industry, and mutual assisting of each other (says Catesby) in rolling these globular balls from the place where they made them to that of their interment, which is usually the distance of some yards, more or less. This they perform breech foremost, by raising their hind parts, and forcing along the ball with their hind feet. Two or three of them are sometimes engaged in trundling one ball, which from meeting with impediments from the unevenness of the ground, is sometimes deserted by them: it is however attempted by others with success, unless it happen to roll into some deep hollow or chink, where they are constrained to leave it; but they continue their work by rolling off the next ball that comes in their way. None of them seem to know their own balls, but an equal care for the whole appears to affect all the community. They form these pellets while the dung remains moist, and leave them to harden in the sun, before they attempt to roll them. In their moving of them from place to place, both they and the balls may frequently be seen tumbling about over the little eminences that are in their way : they are however not easily discouraged, and, by repeating their attempts, usually surmount the difficulties."

Catesby says also, that " they find out their subsistence by the excellency of their *noses*," which direct them in their flight to newly fallen dung, on which they immediately go to work, tempering it with a proper mixture of earth. So intent are they always upon their employment, that though handled or otherwise interrupted, they are not to be deterred, but immediately on being freed, persist in their work without any apprehension of danger *.

They are said to be so exceedingly strong and active, as to move about things, many times their own weight, with the greatest ease. Dr. Brickell was one evening in a planter's house of North Carolina, and two of them were conveyed without his knowledge, under the candlesticks. A few blows were struck on the table, and to his great surprise the candlesticks began to move about, apparently without any agency: and his surprise was not much lessened, when on taking them up he discovered only a beetle under each †.

Professor Thunberg and Mr. Browne both mention the operations of a species of beetle in the different parts of Africa that they visited, which agree in every respect with those of the present species.

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* Catesby, *Appendix, 11.* † Brickell, 161.

THE STAG BEETLES.

The antennæ of the Stag Beetles have a clavate extremity divided into short comb-like leaves. The jaws are toothed, and stretched so far beyond the head as to resemble horns. Under the lip are two palpi or feelers so thickly covered with hair as to appear like tufts.

These insects are chiefly found in rotten and half decayed wood, and under the bark of trees.

THE GREAT STAG BEETLE*.

This is the largest of any insect found in Great Britain, measuring sometimes near three inches from the points of its jaws to the extremity of the abdomen. Its colour is entirely dark brown, except the jaws, which are sometimes as red as coral, and give to it a very beautiful appearance: by these, which somewhat resemble in form the horns of the stag, it is readily distinguished from all other insects.

The larvæ, which are round and whitish, with rust-coloured head and legs, are lodged under the bark, and in the hollows of old trees, into

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*Lucanus Cervus. *Linn.*

which they eat. Here they undergo their necessary changes.

The perfect insects remain hidden during the day in the stumps or among the roots of old elm or oak trees, flying and feeding on the leaves only in the evenings. Their jaws, with which they pinch very severely, if carelssely handled, are supposed to be used in stripping off their food, or fixing themselves firmly to the spot while they eat.

An intimate and intelligent friend of the editor informed him that he had often found several heads of these insects together, all perfectly alive, while the trunks and abdomens were no where to be seen: sometimes only the abdomens were gone, and the heads and trunks were left together. How this circumstance took place he never could discover with any certainty: he supposes, however, that it must have been in consequence of the severe battles that at times take place among these fiercest of the insect tribes: but their mouths not seeming formed for animal food he is at a loss to guess what becomes of the abdomens. They do not fly till most of the birds have retired to rest, and indeed if we were to suppose that any of these devoured them it would be difficult to say why the heads or trunks alone should be rejected.

Linnæus says that they feed on the liquor that oozes from the trunks or branches of decayed oak trees.

THE PTINI.

These insects have antennæ that are nearly of an equal thickness throughout; the last joints however are somewhat larger than the rest. The thorax is nearly round, unmargined, and contains the head.

Their larvæ are found in the trunks of decayed trees; among hay, dried leaves, &c. and in collections of dried plants those of one of the species are sometimes known to do great mischief.

THE DEATH-WATCH PTINUS [*].

The Death-watch is a dusky and somewhat hairy insect, with irregular brownish spots, about a quarter of an inch in length. Notwithstanding its smallness, this creature is often the cause of serious alarm among the lower class of people, from the noise that it makes, at a certain time of the year, resembling the ticking of a watch. From this it has its name, for whenever this faculty is exerted, it is esteemed portentive of death to some one of the family in the house where it is heard. The philosopher and the naturalist may smile at a superstition thus absurd; yet Sir Thomas Brown has remarked with great earnestness. that the man "who could eradicate this error from the minds of the people, would save from many a cold sweat the meticulous heads of nurses and grand-mothers[†]."

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[*] Synonyms.—Ptinus Pulsator. *Linn.*—Ptinus fatidicus. *Shaw's Nat. Mis.*

[†] Vulgar Errors.

It is chiefly in the advanced state of spring that these insects commence their noise, which is no more than the call or signal by which they are mutually attracted to each other, and may be considered as analogous to the call of birds. This noise does not arise from the voice, but from the insects beating on any hard substance with the shield or forepart of the head. The general number of successive distinct strokes is from seven to nine or eleven. These are given in pretty quick succession, and are repeated at uncertain intervals: and in old houses, where the insects are numerous, they may be heard, if the weather be warm, almost every hour in the day. The noise exactly resembles that made by beating moderately hard with the nail on a table*.

The insect being difficult to discover from its obscure greyish-brown colour, nearly resembling that of decayed wood, it is not always easy to say from what exact spot the sound proceeds. Mr. Stackhouse observed carefully the manner of its beating: he says the insect raises itself on its hinder legs, and with the body somewhat inclined, beats its head with great force and agility against the place on which it stands. One of them on a sedge-bottomed chair exerted so much force that its strokes were impressed and visible in the exterior coat of the sedge for a space equal to that of a silver penny. Mr. S. took this insect and put it into a box. On the following day he opened the box and set it in the sun: it seemed very brisk, and crept about with great activity on the bits of sedge and rotten wood, till at last getting to the end of one of the pieces it immediately extended its wings and was about to take leave, when he shut down the lid, and it withdrew its wings and remained quiet. He kept it by him about a fortnight[*].

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* Shaw's Nat. Mis. iii. 104.

The idea of taming this little animal may appear absurd ; it has however been so much familiarized as to be made to beat occasionally by taking it out of its confinement and beating with the nail on a table or board, when it would answer very readily, and even continue to repeat its efforts as long as it was required.

Dr. Derham kept a male and female together in a box for about three weeks ; and by imitating their noise, he made them beat whenever he pleased. At the end of this time one of them died, soon after which the other gnawed its way out and escaped[†].

This insect, which is the real Death-watch of the vulgar, emphatically so called, must not be confounded with a wingless insect not much unlike a louse, that makes a ticking noise like a watch, but instead of beating at intervals, continues its noise for a considerable length of time without intermission. The latter belongs to a tribe very different from this; it is the Termes Pulsatorium of Linnæus, and will be described in its proper place in the present work.

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[*] Phil. Tran. vol. xxxiii. p. 1 9.

[†] Phil. Tran. vol. xxii. p. 832.—See also a paper of Mr. Allen, in vol. 20. p. 376.

THE WEEVIL TRIBE.

The larvæ of the Weevils have, like those of the other coleopterous insects, six legs and a scaly head. They bear a resemblance to oblong soft worms. Some of them infest granaries, where, from their numbers and voracity, they often commit great ravages among the corn: some live in fruits, the insides of artichokes, thistles and other plants; and others devour the leaves of trees and vegetables.

The perfect insects have clavate antennæ, seated on the snout, which is horny and prominent. They have also four thread-shaped feelers.

THE CORN WEEVIL,*

Is well known to most farmers from the devastations that it often makes in their granaries. It is of a black-brown colour, and scarcely more than a tenth of an inch in length. Its snout is long and small; and the thorax is punctured and nearly as long as the abdomen.

The larvæ of these insects find means, while very small, to introduce themselves into grains of corn, which they afterwards make their abode; and it is very difficult to discover them as they lie concealed within. There they increase their size, and with it their dwelling, at the expence of the interior farinaceous parts of the grain, on which they feed. Cornlofts are often laid waste by these grubs whose numbers are sometimes so great as to devour nearly the whole of their contents.

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* Curcurio granarius. *Linn.*

When the larva has attained its full size it remains within the grain, hidden under the empty husk. There being transformed, it becomes a chrysalis; and when it has attained its perfect state, it forces its way out.

It is no easy matter to discover by the eye even the grains that are thus attacked, for in exterior appearance they are still large and full. If, however, they are thrown into water their lightness soon detects them.

To rid a granary of these destructive insects it has been recommended to farmers to spread their corn in the sun, when they will creep out of their holes; and by often stirring the corn while in this situation it is supposed they may be completely expelled. It is also said that they may be destroyed by strewing boughs of elder, or branches of henbane among the corn. In a late Paris Paper a gentleman says, that about the month of June, when his granaries and barns, that had been much infested by Weevils, were all empty, he caused a number of the hills of the large ants to be collected in bags, and placed in different parts about them. The ants immediately attacked the Weevils that were about the walls and other parts, and destroyed them so completely that in a very short time not a single one was to be seen; and since that period he says they have never appeared on his premises.

THE NUT WEEVIL[*].

This insect is produced from the white grub that we often find living in the interior of the hazel nut. The history of its changes and growth is singular and pleasing; and exhibits a striking instance of the care that has been taken to promote the comfort and convenience of the whole of even these diminutive tribes.

The caterpillar or grub proceeds from a very small brown egg that the parent insect deposits in the outside of the nut, at a time when it is very soft and tender. When the heat of the season has perfected the little caterpillar it eats its way out of the egg, and through the shell into the nut, without in the least injuring the external appearance of the nut. His chief food now is the coat of the nut, or that part which afterwards hardens into the shell; and he continues to feed on this and the interior pulp till such time as the one becomes too hard and the other too dry for his sustenance. He then begins on the kernel, which is now grown so large as to afford him support: and it is to be remarked that this seems a most providential instinct, for had he commenced his attacks on the kernel when it was small, he would have destroyed that on which all his future welfare depended, and that which is the principal food allotted to him by nature while in a caterpillar state. While feeding, he constantly attends to the hole by which he entered, gnawing away the sides so as to make them very round and smooth; for this not only allows him sufficient air, and a place through which he can expel the particles of his dung, but it is also the passage through which when he is full fed and ready to undergo his change, he makes his way out. About the month of September, or perhaps somewhat later, the nut becomes ripe and falls to the ground. At this time he is generally prepared for the change, and works himself through the hole, which he is some time in doing, as it is much less in circumference than his body. He then buries himself in the earth, and, shortly after, changes into a chrysalis, in which state he remains till the following spring, and about the beginning of May assumes his beetle form.

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[*] SYNONYMS.—Curculio nucum. *Linn.*—Nut Beetle. *Harris.*

In this state the insect is about a quarter of an inch in length, of a grey-brown colour, with a snout as long as the body. The wing-cases are marbled; the scutellum is white, and the abdomen pointed.

THE CAPRICORN BEETLES.

The insects of the present tribe are among th most beautiful that are produced. Their antenn are frequently longer than the body. Many of th species diffuse a strong, but seldom an unpleasa smell, perceptible at a great distance; and some them when seized emit a sort of cry produced by th friction of the thorax on the upper part of the abdomen and wing-cases.

The antennæ are tapering and articulated. The thorax has several prominences; and the wing-cases are long and narrow. To the mouth are four palpi or feelers.

Their larvæ are found in the inner parts of trees through which they bore, feeding on and pulverizing the substance of the wood. They are transformed into perfect insects in the cavities they thus make, and never issue from their retreats till they have attained their perfect state.

THE TIMBER CAPRICORN*.

The body of this inects is of a dark violet, somewhat hairy and punctured. The thorax is rounded and downy; and the antennæ are nearly as long as the body. The wing cases are narrow, rounded at the tip, and bulging towards the base. The head and thorax are sometimes greenish. The body is from four lines and a half to seven and a half in length.

It feeds principally on fir timber which has been felled some time without having had the bark stripped off; but it is often found on other wood. Though now too common in this kingdom, it is supposed not to have been originally a native.

The circumstance of this destructive little animal attacking only such timber as has not been stripped of its bark, ought to be attended to by all persons who have any concern in this article; for the bark is a temptation not only to this but to various other insects, and much of the injury done to timber might be prevented, if the trees were all barked as soon as they are felled.

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* Cerambyx violaceus. *Linn.*

The female is furnished with a flat retractile tube. This she inserts between the bark and the wood, to the depth of about a quarter of an inch, and there deposits a single egg.

By stripping off the bark it is easy to trace the whole progress of the larva, from the spot where it is hatched to that where it attains its full size. It first proceeds in a serpentine direction, filling the space which it leaves with its excrement, resembling saw-dust, and so stopping all ingress to enemies from without. When it has arrived at its utmost dimensions, it does not confine itself to one direction, but works in a kind of labyrinth, eating backwards and forwards, which gives the wood under the bark a very irregular surface: by this means its paths are rendered of considerable width. The bed of its paths exhibits, when closely examined, a curious appearance, occasioned by the erosions of its jaws, which excavate an infinity of little ramified canals. When the insect is about to assume its chrysalis state, it bores down obliquely into the solid wood, to the depth sometimes of three inches, and seldom if ever less than two. These holes are nearly semicylindrical expressing exactly the form of the grub.

At first sight one would wonder how so small and seemingly so weak an animal could have strength to excavate so deep a mine; but when we examine its jaws, our wonder ceases; these are large, thick, and solid sections of a cone divided longitudinally, which in the act of mastication apply to each other the whole of their interior plane surface, so that they grind the insect's food, like a pair of millstones.

Some of the larvæ are hatched in October, and it is supposed that about the beginning of March they assume their chrysalis state. At the place in the bark opposite to the hole from whence they descended into the wood, the perfect insects gnaw their way out, which generally takes place betwixt the middle of May and the middle of June.

These insects are supposed to fly only in the night, but during the day they may generally be found resting on the wood from whence they were disclosed.

The larvæ are destitute of feet, pale, folded, somewhat hairy, convex above, and divided into thirteen segments. Their head is large and convex*.

THE FIRE-FLIES.

The antennæ are thread-shaped. The thorax is plain, somewhat orbicular and conceals the head.

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* Kirby in Linn. Tran. v. 246. tab. 12

The segments of the abdomen terminate in folde papillæ.

The female in most of the species is destitute o wings; and the larvæ, which feed chiefly on leaves perfectly resemble her in appearance.

THE GLOW-WORM*.

The male Glow-worm is smaller than the female: their heads are of the same shape, and equally concealed by the plate of the thorax. The principal difference between the sexes is that the abdomen of the male is covered with brown wing-cases, shagreened and marked longitudinally with two lines; these are longer than the abdomen.

Each sex is luminous, but in the male the light is less brilliant, and confined to four points, two of which are situated on each of the two last rings of the abdomen.

Glow-worms are frequently met with towards evening in the month of June, in woods and meadows. The utility of the bright light of the females is supposed to consist in attracting the attention of the males during the dark, when, alone, they are able to render themselves conspicuous. They always become much more lucid when they put themselves in motion. This would seem to indicate that their light is owing to their respiration; in which process, it is probable, phosphoric acid is produced by the combination of oxygen gas with some part of the blood, and that a light is given out through their transparent bodies by this slow internal combustion. By contracting themselves, the insects have a power of entirely withdrawing it: when they are at rest very little light is to be seen. Mr. Templer, who made many observations on these insects, says that he never saw a Glow-worm exhibit its light at all, without some sensible motion either in its body or legs. This gentleman, when the light was most brilliant, fancied it emitted a sensible heat*.

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* Lampyris noctiluca. *Linn.*

If the insect is crushed, and the hands or face are rubbed with it, they contract a luminous appearance similar to that produced from phosphorus. When a Glow-worm is put into a phial, and the phial is immersed in water, a very beautiful irradiation will be found to take place.

THE SKIPPERS.

The antennæ of the Skippers are of equal thickness throughout, and lodged in a groove under the head and thorax. The thorax terminates in a strong elastic spine which is placed in a cavity of the abdomen: by means of this, when the insects happen to be thrown on their back, they are enabled to spring up, and recover their natural position. They raise up the middle part of their body, so as to leave only the head and tail in contact with the plane on which they lie. The spine of the thorax is by this motion brought considerably out of its lodgment, and made to press against the side. Being from this position again slipped into its groove, with all the force the creatures are able to exert, the thorax and abdomen come together with so sudden a jerk, as to raise the body from the plane, and enable them to spring round.

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* Phil. Tran. vol. 6.

The larvæ live and undergo their changes in the trunks of decayed trees.

THE NIGHT-SHINING SKIPPER*

Is of an oblong form, and an inch or upwards in length. It is so strong and exerts such elastic powers as, when placed on its back, sometimes to spring to the height of four or five inches in recovering its natural position. Its colour is brown, except the head which is small and blackish. In the Savannas of most of the warmer parts of America, these insects are to be seen in great abundance, and also about the woods of several of the West India islands.

They are extremely luminous in the dark, the light proceeding chiefly from four parts; from two glandular spots behind the eyes, and one under each wing. But they have the property of interrupting this light at pleasure, when these glandular spots become perfectly opake. When the rings of the abdomen are forced a little asunder, the same luminous appearance will be seen to issue indiscriminately from every part of their interior.

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* SYNONYMS.—Elater noctilucus. *Linn.*——Larger fire-fly— *Browne.* Flies shining like Glow-worms. *Purchas.*

A person may with great ease read the smallest print by the light of one of these insects held between the fingers, and gradually moved along the lines with the luminous spots above the letters: but if eight or ten of them be put into a phial, the light will be sufficiently great to admit of writing by it. Oviedo says that the Indians travel in the night with them fixed to their feet and hands; and that they spin, weave, paint, dance, &c. by their light. He also conjectures that "a marvellous water would come from them if distilled!"

They are seldom to be seen abroad during the day, for except in the night, they are so inanimate, as even scarcely to exhibit any signs of life. The Indians principally value them from their hunting and devouring the Musquitoes in their habitations, which become otherwise excessively troublesome. They catch them in the night by holding up a torch on some eminence, to the light of which they soon come, when they are beaten down with the branches of trees; or sometimes one of them is held up in the fingers and moved about, which will attract such as are near to the place, when they are either knocked down or seized with the hand*.

The use of their light, as in the Glow-worms, seems to consist in discovering the sexes to each other.

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* Browne's Jamaica, p. 432. t. 44. fig. 10.—Sloane, ii. 206.

THE GROUND BEETLES.

These insects are very active and voracious, devouring the larvæ of the other tribes, and indeed all the smaller animals they can overcome. Their larvæ are found under ground, or in decayed wood.

The antennæ are thread-shaped; and the feelers mostly six, the last joint obtuse. The thorax is flat, and both this and the shells are margined.

THE BOMBADIER*.

This insect keeps itself concealed among stones, and seems to make little use of its wings. When it moves it is by a sort of jump; and when it is touched we are surprised with a noise resembling the discharge of a musket in miniature, during which a blue smoke may be perceived to proceed from its extremity. The insect may at any time be made to play off its artillery by scratching its back with a needle. If we may believe Rolander, who first made these observations, it can give twenty discharges succeſsively. A bladder, placed near its posterior extremity, is the arsenal that contains its store. This is its chief defence against its enemies, and the vapour or liquid that proceeds from it is of so pungent a nature that if it happens to be discharged into the eyes it makes them smart as though brandy had been thrown into them. Its principal enemy is another insect of the same genus, but three or four times its size. When pursued and fatigued, the Bombadier has recourse to this stratagem. It lies down in the path of its enemy, who advances with open mouth and claws to seize it; but on the discharge of the artillery this suddenly draws back, and remains for a while confused, during which the Bombadier conceals himself in some neighbouring crevice; but if not lucky enough to find one, the other returns to the attack, takes the insect by the head, and tears it off.

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* Carabus crepitans. *Linn.*

The head, antennæ, thorax, and feet are of a brownish red colour; the eyes are black, and the abdomen and wing-cases blue, bordering on black; the latter are marked with broad but shallow striæ. It is sometimes found in this country.

THE LYTTA TRIBE.

The antennæ of the Lyttæ are of equal thickness throughout; the feelers are four, unequal, the hind ones being clavate. The thorax is roundish: the head inflected and gibbous. The shells are soft, flexile, and as long as the abdomen.

THE BLISTERING LYTTA *.

The blistering Lytta is chiefly found on ash and alder trees in several parts of the continent, but

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* Lytta vesicatoria. *Linn. Gmel.* Spanish-fly. Cantharis. *var.*

most commonly on the southern coasts. It is about an inch long, and of a shining blue-green colour. These insects sometimes fly in swarms, and have a nauseous smell not much unlike that of mice. When dried they are so light that fifty of them will scarcely weigh a single drachm.

They feed on the leaves of trees and shrubs; and those who gather them tie them in a bag or piece of linen cloth that has been well worn, and in this kill them with the vapours of hot vinegar; after which they dry them in the sun and keep them in boxes.

The odorous particles exhaled by these insects are extremely corrosive, and it is necessary to use great caution in taking them up. People have felt their dangerous effects by gathering a quantity of them, during the heat of the sun, with their hands bare, or in having fallen asleep under the trees where swarms of them had settled. They are used in blistering plasters, and for other purposes in medicine: the name by which they are best known is that of *Cantharides.*

THE EARWIGS.

In this tribe the antennæ are bristled-shaped; and the feelers unequal and thread-shaped. The wing-cases are half the length of the abdomen, and have the wings folded up under them. The tail armed with a forceps.

THE COMMON EARWIG*

Is a well-known insect, and easily distinguishable from all others of the Coleoptera by the forceps or pincers at the end of its tail. It is produced from an egg, and the larva differs very little in its external appearance from the complete insect, except that it is destitute both of wings and elytra, and that the breast and thorax are not distinguishable. It is in this state very lively, running about with great agility, even from the instant it leaves the egg. In its metamorphosis to a perfect insect, a part of its body bursts behind, and gives full play to the wings.

It may not, perhaps, be known to the generality of observers, that the Earwig is possessed of wings which are both large and elegant, and that even one of them when extended will nearly cover the whole insect. The elytra are short, and extend not along the whole body but only over the breast. The wings are concealed beneath these; they are somewhat of an oval shape, and when extended are nine or ten times as large as the elytra. There is a great degree of elegance in the manner in which the insect folds them beneath. They are first closed up lengthways from a centre close to the body like a fan, and afterwards refolded across in two different places, one about the middle of the membrane, and the other at the centre from whence the first folds proceeded. By this means the wing is reduced into a small compass and proportioned to the size of the elytra, under which it is to lie.

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* *Forficula auricularia. Linn.*

It is a circumstance extremely singular that unlike those of most others of the insect tribe, the eggs are hatched and the young earwigs, fostered by the parent. At the beginning of the month of June, M. De Geer found under a stone a female Earwig, accompanied by many little insects, which evidently appeared to be her own young. They continued close to her, and often placed themselves under her belly as chickens do under a hen. He placed the whole in a box of fresh earth: they did not enter the earth, but it was pleasing to observe how they thrust themselves under the belly and between the legs of the mother, who remained very quiet, and suffered them to continue there sometimes for an hour or two together. To feed them, this gentleman gave them a piece of a very ripe apple; in an instant the old one ran upon it and ate with a good appetite; the young ones also seemed to eat a little, but apparently with much less relish. On the eighth of June he remarked that the young Earwigs had changed their skins, and he found also the ſloughs that they had quitted. This moulting, produced only a slight change in their figure, yet it evidently brought them nearer to the perfect insect.

At another time, about the beginning of April, he found a female Earwig under some stones, placed over a heap of eggs, of which she took all the care imaginable without ever forsaking them. He took both the female and her eggs, placed her in a box half filled with fresh earth, and dispersed the eggs up and down in it. She, however, soon removed them one after another, carrying them between her jaws, and at the end of a few days he saw that she had collected them all into one place upon the surface of the earth, and remained constantly on the heap, without quitting it for a moment, so that she seemed truly to sit for the purpose of hatching her eggs. The young were produced about the thirteenth of May: in figure they were similar to those before mentioned, but at their birth they were all white except towards the tail, where a yellow matter was observable through the ſkin, and the eyes and teeth, which were reddish. He kept them in the box with their mother, feeding them from time to time with bits of apple, and saw them grow every day, and change their skins more than once. The mother died, and her progeny devoured nearly the whole of her body. The little ones that died underwent also the same fate; M. De Geer, however, conjectures that this took place only from want of other food, as he had neglected to supply them regularly with nutriment. On the twenty-third of July one only remained alive; it was full grown, and then in the nymph or pupa state.

This insect, though in its nature extremely harmless except in our gardens to our fruits and vegetables, has unaccountably fallen a very particular victim to human cruelty and caprice, originating in the idea that it introduces itself into the ears, and from thence penetrates to the brain and occasions death. We cannot help expressing a wish that females, who but too commonly lay aside all ideas of tenderness at the very sight of it, would be convinced that the wax and membranes of the ears are a sufficient defence against all its pretended attacks upon this organ.

Our gardeners have, it is true, some room for complaint. It lives among flowers, and frequently destroys them; and when fruit has been wounded by flies, the Earwigs also generally come in for a share. In the night they may often be seen in amazing numbers upon lettuces and other esculent vegetables, committing those depredations that are often ascribed to snails or slugs. The best mode therefore of destroying them seems to be to attend the garden now and then in the night, and to seize them while they are feeding.

The bowl of a tobacco-pipe, and the claws of lobsters stuck upon sticks that support flowers, are the usual methods by which they are taken, as, in the day-time they creep into holes and dark places. Placing hollow reeds behind the twigs of wall-trees is also a good mode, if they be examined and cleared every morning. But at a midnight visit more may be done in an hour than by any of the other means in a week.

THE MANTIS TRIBE.*

THE insects composing the present tribe have, in general, at a little distance, so much the appearance of leaves of trees, that, in countries where they are very common, travellers have been struck with the singular phenomenon of what seemed to them animated vegetable substances. Their most prevailing colour is a fine green, but many of the insects become brown after they are dead: some of them are however decorated with a variety of lively hues. The thorax in most of them is very long and narrow, and has the appearance of a footstalk to their large and rounded abdomen. Their manners also, in addition to their structure, are very likely to impose on the senses of the uninformed: they often remain on the trees for hours without motion, then suddenly rising spring into the air, and, when they settle, again appear lifeless. These seem to be stratagems to deceive the more cautious insects which they feed upon. Some travellers who have observed them, have, however, declared that they saw the leaves of trees become living creatures. Many of the Indians of South America, who have these insects very common among them, believe that they grow like leaves on the trees, and that when they have arrived at maturity they loosen themselves and crawl or fly away.

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* The Linnæan order HEMIPTERA commences here.

The Africans consider the whole tribe, according to some writers, as sacred, but according to others only as animals of good omen. One of the species (Mantis fausta) has obtained the name of the *Hottentot's God*, and is supposed to be worshipped by this people. Professor Thunberg could not however observe any reason for this supposition: he says it is held by them in such esteem that they would not willingly injure it; and that they account any person or creature fortunate on whom it settles, but all this appeared to him to be done without paying it any sort of worship *.

None of the species have ever been found in this country.

The head in the whole tribe is unsteady, and appears but slightly attached to the thorax. The mouth is armed with jaws, and has its feelers filiform. The wings are four, membranaceous, and convolute, the under ones plaited. The fore legs are compressed, serrated or toothed beneath, and armed with a single claw and a lateral jointed process. The four hind legs are smooth and formed for walking, and not for leaping, as in the next genus.

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* Thunberg, ii. 66.

THE ORATOR MANTIS *.

This is a very widely diffused species, being found in Africa and Asia as well as in all the warmer parts of Europe. Its thorax is smooth, and wing-cases of a bright and unspotted green.

The *Mantis religiosa* is supposed to be merely a variety of this species, differing from the rest in having a somewhat keel-shaped thorax. This however seems to be the most generally known of the two. It has its name of *over-religious* or *superstitious* from its perpetual resting on its hind-legs and erection of the fore-paws close together, with a quick motion as if in the action of praying. The country people in many parts of the continent look upon it almost as sacred, and would not on any account injure it. "It is so divine a creature, (says the translator of Mouffet) "that if a child has lost its way, and enquires of the Mantis, it will point out the right path with its paw." Dr. Smith however informs us, in his Tour on the Continent, that he received an account of this Mantis that seemed to savour little of divinity. A gentleman caught a male and female and put them together in a glass vessel. The female, which in this, as in most other insects, is the largest, after a while devoured first the head and upper parts of her companion, and afterwards all the remainder of the body.

The young of this Mantis are preserved in the egg-state in a kind of oblong bag, of a thick spungy substance; this bag is imbricated on the outside, and fastened lengthwise to the branch of some plant. As the eggs ripen they are protruded through the thick substance of the bag, and the larvæ, which are about half an inch in length, burst from them.

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* Mantis oratoria.—*Linn.*

Roesel, wishing to observe the gradual progress of these creatures to the winged state, placed the bag containing the eggs in a large glass, which he closed, to prevent their escape. From the time they were first hatched they exhibited marks of a savage disposition. He put different sorts of plants into the glass, but they refused them to prey on one another. This determined him to supply them with insect food. He put several ants into the glass to them, but they then betrayed as much cowardice as they had before done of barbarity; for the instant the Mantes saw the ants they attempted to escape in every direction. This was evidently an instinctive fear of a natural enemy. He next gave them some of the common house-flies, which they seized with eagerness in their fore-claws and tore in pieces. But notwithstanding their apparent fondness of flies, they continued to destroy each other through savage wantonness. Despairing at last, from their daily decrease, of rearing any to the winged state, he separated them into small parcels in different glasses; but here, as before, the strongest of each community destroyed the rest.

He afterwards received several pair of Mantes in the winged state: profiting by his former observations, he now separated them, a male and a female together into different glasses, but they still exhibited signs of a rooted enmity to each other which neither age nor sex could soften. The instant they were in sight of each other they threw up their heads, brandished their fore legs, and each waited an attack. They did not long remain in this posture, for the boldest throwing open his wings with the velocity of lightning, rushed at the other, and often tore it in pieces. Roesel compares the attack of these creatures to that of two hussars: for they dexterously guard and cut with the edge of the fore claws, as those soldiers do with sabres, and sometimes at a stroke one of them cleaves the other through, or severs its head from the thorax. After this the conqueror always devours his vanquished antagonist.

The patience of the Mantis in waiting for its prey is remarkable, and the posture to which superstition has attributed devotion, is no other than the means it uses to catch it. When it has fixed its eyes on an insect, it very rarely loses sight of it, though it may cost some hours to take it. If it sees an insect a little beyond its reach, over its head, it slowly erects its long thorax, by means of the moveable membranes that connect it to the body; then, resting on the posterior legs, it gradually raises the anterior part also. If this brings it near enough to the insect, it throws open the last joint of its fore paws, and snaps it between the spines that are set in rows on the second joint. If it is unsuccessful it does not retract its paws, but holds them stretched out, and waits again till the insect is within its reach, when it springs up and seizes it. Should the insect go far from the spot, it flies, or crawls after it, slowly on the ground like a cat, and when the insect stops, erects itself as before.

These Mantes have a small black pupil or sight which moves in all directions within the parts that we usually term the eyes, so that they can see their prey in any direction without having occasion to disturb it by turning their head.

The males die in October, and the females do not long survive them*.

THE DRY-LEAF MANTIS †.

This insect in its shape and colour is so exceedingly remarkable, as to have uniformly suggested the idea of a dry or withered leaf; and the animal, when its wings are closed, bears so great a resemblance to such, that, on a cursory view, it might easily be mistaken for it.

The specimens that are brought to Europe are generally of a yellowish brown colour. The wings when closed, form the oval body of the leaf, and the narrow thorax and head, resemble the stalk. It is a native of India ‡.

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* Donovan's Chinese Insects.—Roesel Insecten Belustigung.

† Mantis siccifolia. *Linn.*

‡ Shaw's Nat. Mis. iv. t. 119.

THE LOCUST TRIBE.

The insects of this tribe feed chiefly on vegetable substances. The larvæ and chrysalids very much resemble the perfect insects; they have six legs, are voracious and active, and reside principally in the ground.

Their heads are inflected, and armed with jaws, that are furnished with filiform palpi or feelers. The antennæ in some species are taper, in others thread-shaped. The wings are four, deflected and convolute; the lower ones plaited. The hind legs are formed for leaping; and on each of the feet are two claws.

THE MOLE CRICKET *.

The fore feet of this insect are strong, and placed like those of a mole, so as to be useful in burrowing; it generally, however, moves backwards. It commonly resides under the ground, into which it penetrates even more expeditiously than the mole.

The female forms a cell of clammy earth, about the size of a hen's egg, closed up on every side, and within as large as two hazel nuts. The eggs, amounting to about a hundred and fifty, are white, and about the size of caraway comfits; they are carefully covered, as well to defend them from the injuries

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* Synonyms.—Gryllus Gryllo-talpa. *Linn.*——Fen Cricket, Churr-worm, Eve churr, in different parts of the kingdom.

of the weather, as from the attacks of one of the species of black beetles. The female places herself near the entrance of the nest, and whenever the beetle attempts to seize its prey, the guardian insect catches it behind and bites it asunder. Nothing can exceed the care of these animals in the preservation of their young. Wherever a nest is situated, fortifications, avenues and entrenchments surround it; there are also numerous meanders which lead to it, and a ditch encompasses the whole, which few other insects are capable of passing.

This creature makes great havoc in hot-beds, by hacking and gnawing the roots of plants with its fore feet which are armed with teeth like a saw.

About the middle of April, if the weather be fine, and just at the close of day, the Mole Crickets utter a low, dull, jarring note, not much unlike the chattering of the Goat-sucker. In the beginning of May they lay their eggs. Mr. White says that "a gardener at a house where he was on a visit, happening to be be mowing by the side of a canal, on the sixth of May, his scythe struck too deep, pared off a large piece of turf, and laid open to view a curious scene of domestic œconomy. There were many caverns and winding passages leading to a kind of chamber, neatly smoothed and rounded, and about the size of a moderate snuff-box. Within this secret nursery were deposited near a hundred eggs of a dirty yellow colour, and enveloped in a tough skin, but too lately excluded to contain any rudiments of young, being full of a viscous substance. The eggs lay but shallow, and within the influence of the sun, just under a little heap of fresh mould like that which is raised by ants."

At the approach of winter, the Mole Crickets remove their nest to so great a depth in the earth as to have it always lower than the frost can penetrate. When the mild season comes on they raise it in proportion to the advances of that favourable time, and at last elevate it so near the surface as to render it susceptible both of air and sun-shine: and if the frost returns, they again sink it to its proper depth. A method very similar is practised by the ants with their nests *.

THE HOUSE CRICKET †.

These busy little insects reside altogether in our dwellings and intrude themselves on our notice whether we wish it or not. They are partial to new-built houses, for the softness of the mortar enables them to form their retreats, without much difficulty, between the joints of the masonry, and immediately to open communications with the different rooms. They are particularly attached to kitchens and bakehouses, as affording them a constant warmth.

"Tender insects that live abroad (says Mr. White) either enjoy only the short period of one

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* White's Natural History of Selborne.

† Gryllus domesticus. *Linn.*

summer, or else doze away the cold uncomfortable months in profound slumbers; but these, residing as it were in a torrid zone, are always alert and merry: a good Chrismas fire is to them what the heats of the dog-days are to others. Though they are frequently heard by day, yet their natural time of motion is only in the night. As soon as it becomes dusk, the chirping increases, and they come running forth, and are to be seen often in great numbers from the size of a flea to that of their full stature.

Around in sympathetic mirth
  Its tricks the kitten tries,
The Cricket chirrups in the hearth,
  The crackling faggot flies.

"As one would suppose from the burning atmosphere which they inhabit, they are a thirsty race, and show a great propensity for liquids, being found frequently drowned in pans of water, milk, broth, or the like. Whatever is moist they are fond of, and therefore often gnaw holes in wet woollen stockings and aprons that are hung to the fire. These Crickets are not only very thirsty, but very voracious; for they will eat the scummings of pots, yeast, salt, and crumbs of bread; and any kitchen offal or sweepings.

"In the summer we have observed them to fly, when it became dusk, out of the windows, and over the neighbouring roofs. This feat of activity accounts for the sudden manner in which they often leave their haunts, as it does also for the method by which they come to houses where they were not known before. It is remarkable, that many sorts of insects seem never to use their wings but when they wish to shift their quarters and settle new colonies.—When in the air they move in waves or curves, like wood-peckers, opening and shutting their wings at every stroke, and thus are always rising or sinking.—When they increase to a great degree, as they once did in the house where I am now writing, they become pests, flying into the candles and dashing into people's faces; but they may be blasted by gunpowder discharged into their crevices and crannies. In families, at such times they are, like Pharaoh's plague of frogs,—" in their bed-chambers, and upon " their beds, and in their ovens, and in their kneading troughs."

" Cats catch hearth-crickets, and, playing with them, as they do with mice, devour them. Crickets may be destroyed like wasps, by phials half filled with beer, or any liquid, and set in their haunts; for being always eager to drink they will crowd in till the bottles are full *." A popular prejudice, however, frequently prevents any attempts at their destruction, many people imagining that their presence is attended with good luck, and that to kill or drive them away will surely bring on some unfortunate occurrence to the family.

When these insects are running about a room in the dark, if they are surprized by a candle, they

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* White's Natural History of Selborne.

give two or three shrill notes. These seem a signal to their fellows, that they may escape to their crannies and lurking holes to avoid danger.

It is said that in some parts of Africa persons make a trade of these Crickets. They feed them in a kind of iron oven, and sell them to the natives, among whom the noise they make is thought pleasing. These people imagine that it assists in lulling them to sleep.

The organ that produces this noise is a membrane, which, in contracting, by means of a muscle and tendon placed under the wings of the insect, folds down somewhat like a fan. This, as it is always dry, yields that sharp, piercing sound that we so often hear from these animals. The noise may also be heard after the insect is dead, if the tendon be made to move.—We are told that Crickets will live and even continue their accustomed noise for some time after the head is cut off.

THE FIELD CRICKET [*].

TOWARDS sun-set is the time when the Field-crickets begin to appear out of their subterraneous habitations.

The Rev. Mr. White, in his Natural History of Selborne, has left us a very pleasing account of the manners and economy of these insects; which, however, he observes, are so shy and cautious, that it is no easy matter to get a sight of them; for feeling a person's footsteps as he advances, they stop short in the midst of their song, and retire backward nimbly into their burrows, where they lurk till all suspicion of danger is over. At first an attempt was made to dig them out with a spade, but without any great success, for either the bottom of the hole was inaccessible from its terminating under a large stone, or else in breaking up the ground the poor creature was inadvertently squeezed to death. Out of one thus bruised a great number of eggs were taken, which were long and narrow, of a yellow colour, and covered with a very tough ſkin. More gentle means were then used, and these proved successful. A pliant stalk of grass, gently insinuated into the caverns, will probe their windings to the bottom and bring out the inhabitant; and thus the humane enquirer may gratify his curiosity without injuring the object of it.

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[*] Gryllus campestris.—*Linn.*

It is remarkable that though these insects are furnished with long legs behind, and brawny thighs adapted for leaping, yet when driven from their holes they shew no activity, but crawl along in so lifeless a manner as easily to be taken. And though they are provided with a curious apparatus of wings, yet they never exert them, even when there seems to be the greatest occasion. The males only make their shrill noise, perhaps, out of rivalry and emulation, as is the case with many animals, which exert some sprightly note during their breeding-time.

When the males meet they sometimes fight very fiercely, as Mr. White found by some that he put into the crevices of a dry stone-wall, where he wished to have them settle. For though they seemed distressed by being taken out of their knowledge, yet the first that got possession of the chinks, seized on all that were obtruded upon them, with a vast row of serrated fangs. With their strong jaws, toothed like the shears of a lobster's claws, they perforate and round their curious regular cells, having no fore claws to dig with, like the mole cricket. When taken in the hand they never attempt to defend themselves, though armed with such formidable weapons. Of such herbs as grow about the mouths of their burrows they eat indiscriminately, and never in the day-time seem to stir more than two or three inches from home. Sitting in the entrance of their caverns they chirp all night as well as day, from the middle of the month of May to the middle of July. In hot weather, when they are most vigorous, they make the hills echo; and in the more still hours of darkness, may be heard to a very considerable distance.

" Not many summers ago (says Mr. White), I endeavoured to transplant a colony of these insects to the terrace in my garden, by boring deep holes in the sloping turf. The new inhabitants staid some time and fed and sang; but they wandered away by degrees, and were heard at a greater distance every morning; so that it appears that on this emergency they made use of their wings in attempting to return to the spot from which they were taken.

" One of these crickets, when confined in a paper cage, set in the sun, and supplied with plants moistened with water, will feed and thrive; and become so merry and loud as to render it irksome to be in the same room with it. If the plants are not wetted it will die *.

THE MIGRATORY LOCUST †.

Syria, Egypt, Persia, and almost all the south of Asia, are subject to a calamity as dreadful as volcanos and earthquakes are to other countries, in being ravaged by those clouds of locusts, so often mentioned by travellers. The quantity of these insects is incredible to all who have not themselves witnessed their astonishing numbers; the whole earth is covered with them for the space of several leagues. The noise they make in browzing on the trees and herbage, may be heard at a great distance, and resembles that of an army foraging in secret. The Tartars themselves are a less destructive enemy than these animals. One would imagine, wherever they have appeared, that fire had followed their progress. Wherever their myriads spread, the verdure of the country disappears, as if a curtain had been removed; trees and plants, stripped of their leaves, and reduced to their naked boughs and stems, cause the dreary image of winter to succeed in an instant, to the rich scenery of the spring.—When these clouds of locusts take their flight, to surmount any obstacle, or to traverse more rapidly a desert soil, the heavens may literally be said to be obscured with them. Happily this calamity is not frequently repeated, for it is the inevitable forerun-

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* Natural History of Selborne.

† Gryllus migratorius. *Linn.*

ner of famine, and all the maladies it occasions. The inhabitants of Syria have remarked that locusts are always increased by too mild winters, and that they constantly come from the desert of Arabia. From this observation it is easy to conceive that the cold, not having been rigorous enough to destroy their eggs, they multiply suddenly, and the herbage failing them in the immense plains of the desert, innumerable legions issue forth. When they make their first appearance on the frontiers of the cultivated country, the inhabitants strive to drive them off, by raising large clouds of smoke, but frequently their herbs and wet straw fail them. They then dig trenches, where numbers of the insects are buried; but their most efficacious destroyers are the south, and south-easterly winds, and the Locust-eating thrushes *. These birds follow them in numerous flocks, like starlings, and not only greedily devour them, but kill as many as they can; accordingly they are much respected by the peasants, and nobody is ever allowed to shoot them. As for the southerly, and south-easterly winds, they drive with violence these clouds of locusts over the Mediterranean, where such quantities of them are sometimes drowned, that, when their carcases are thrown on the shore, they infect the air for several days, even to a great distance.

The annals of most of the warm climates are filled with accounts of the devastations produced by the locusts. They seldom visit Europe in such swarms

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* Turdus gryllivorus of Barrow.

as formerly; yet in the warmer parts of it they are still formidable. Those that have at uncertain intervals visited Europe, in our memory, are supposed to have come from Africa.

These insects are bred in the warm parts of Asia and Africa. They multiply faster than any other animals in the creation, and are truly terrible in the countries where they breed. Some of them have at different times been seen in Britain, and great mischiefs have been apprehended: but, happily for us, the coldness of our climate and the humidity of our soil are very unfavourable to their production; so that, as they are only animals of a year's continuance, they all perish without leaving a young generation to succeed them.

Locusts, when they take the field, are said to have a leader, whose flight they observe, and to whose motions they pay a strict regard. At a distance they seem like a dark cloud, which, as it approaches, almost excludes the light of day. It often happens that the husbandman sees them pass over without doing him any injury; but in this case they only proceed to settle on some less fortunate country. Wherever they alight they make dreadful havoc among the vegetation, destroying even the leaves of the trees. In the tropical climates their presence is not attended with such destructive consequences as in the southern parts of Europe, for in those the vegetative power is so strong and active, that an interval of only a few days repairs all the damage; but in Europe their ravages cannot be obliterated till the succeeding year *. In their long flights to this part of the world they are also, from the extent of their journey, nearly famished, and therefore more voracious wherever they happen to alight.

We are told that nearly as much damage is occasioned by what they touch, as by what they devour. Their bite is thought to contaminate the plants, and either to destroy or greatly to weaken their vegetation. To use the expression of the husbandmen, "They burn wherever they touch, and in some countries leave the marks of their devastation for three or four years afterwards." When dead they infect the air in such a manner that the stench is frequently insupportable. Orosius tells us, that in the year of the world 3800 Africa was infested with a multitude of locusts. After having eaten up every thing that was green, they flew off and were drowned in the sea; where they caused such a stench as could not have been equalled by the putrefying carcases of a hundred thousand men.

In the year 1650 a cloud of locusts were seen to enter Russia in three different places; and from

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* "One thing which always surprized me," says Mr. Adanson, in his Voyage to Senegal, "is the amazing rapidity with which the sap of trees in this country repairs any loss they happen to sustain; and I was never more astonished than when, four days after a terrible invasion by the locusts, in which every green thing was devoured, I saw the trees covered with new leaves; and not appear to have suffered very greatly. The herbaceous plants bore marks of the devastation somewhat longer, but a few days were sufficient to repair every mischief."

thence they spread themselves over Poland and Lithuania in such astonishing multitudes that the air was darkened, and the earth covered with their numbers. In some places they were seen lying dead, heaped upon each other to the depth of four feet; in others, they covered the surface like a black cloth; the trees bent with their weight, and the damage that the country sustained exceeded computation.

In Barbary, their numbers are often formidable; and Dr. Shaw was a witness of their devastations there in 1724. Their first appearance was in the latter end of March, when the wind had been southerly for some time. In the beginning of April, their numbers were so increased that, in the heat of the day, large swarms appeared, like clouds, and darkened the sun. In the middle of May they began to disappear, retiring into the plains to deposit their eggs. In June the young brood came forth, forming many compact bodies of several hundred yards square; which, afterwards marching forward, climbed the trees, walls, and houses, devouring every vegetable that was in their way. The inhabitants, to stop their progress, formed trenches all over their fields and gardens, which they filled with water. Some placed large quantities of heath, stubble, and other combustible matter in rows, and set them on fire on the approach of the locusts. This, however, was all to no purpose, for the trenches were quickly filled up and the fires put out by the immense swarms that succeeded each other.

A day or two after one of these was in motion, others, that were just hatched, came to glean after them, gnawing off the young branches, and the very bark of the trees. Having lived near a month in this manner, they arrived at their full growth, and threw off their worm-like state by casting their skins. To prepare themselves for this change they fixed their hinder parts to some bush or twig, or corner of a stone; when immediately, by an undulating motion, their heads would first appear, and soon after the rest of their bodies. The whole transformation was performed in seven or eight minutes time, after which they remained for a little while in a weak state; but as soon as the sun and air had hardened their wings, and dried up the moisture that remained after casting off their sloughs, they returned to their former greediness, with an addition both of strength and agility. But they did not long continue in this state before they were entirely dispersed. After laying their eggs, they directed their course northward, and probably perished in the sea*.

Of the innumerable multitudes that infested the interior of Southern Africa, in the year 1797, scarcely any adequate conception can be formed. Mr. Barrow says, that in the part of the country where he then was, for an area of near 2000 square miles, the whole surface of the ground might literally be said to be covered with them. The water of a very wide river was scarcely visible on account of the dead carcases that floated on the surface, drowned in the attempt to come at the reeds that grew in it. They had devoured every blade of grass and every green herb except the reeds.—They are not however without a choice in their food. When they, says this gentleman, attack a field of corn just come into ear, they first mount to the summit and pick out every grain before they touch the leaves and stem. The insect seems to be constantly in motion and to have some object in view. When the larvæ, for these are much more voracious than the perfect insects, are on a march during the day, it is utterly impossible to turn the direction of the troop, which is generally with the wind. Towards the setting of the sun the march is discontinued, when the troop divides into companies that surround the small shrubs or tufts of grass, or ant-hills, and in such thick patches that they appear like so many swarms of bees; and in this manner they rest till day-light. At these times it is that the farmers have any chance of destroying them, which they are sometimes able in a great measure to effect by driving among them a flock of two or three thousand sheep; by the restlessness of these great quantities of them are trampled to death.

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* Shaw's Travels, 257.

The year 1797 was the third of their continuance in Sneuwberg, and their increase, according to Mr. Barrow's account, had far exceeded that of a geometrical progression whose ratio is a million.

For ten years preceding their present visit this district was entirely free from them. Their former exit was somewhat singular: all the full-grown insects were driven into the sea by a tempestuous north-west wind, and were afterwards cast upon the beach, where it is said they formed a bank of three or four feet high that extended a distance of near fifty English miles; and it is asserted, that when this mass became putrid, and the wind was at south-east, the stench was sensibly felt in several parts of Sneuwberg, distant at least a hundred and fifty miles*.

In the year 1754 and the three subsequent years great devastations were committed in Spain by the locusts: of this the best account extant is written by Don Guillermo Bowles, and published in Dillon's travels through that country. His description of the mode in which the species is propagated is exceedingly curious.

" The female (he says) when she lays her eggs, which are generally about forty in number, retires to some solitary place under ground, where by her sagacity she secures them from the intemperance of the air, as well as from the more immediate danger of the plough or spade, one fatal blow of which would destroy all her hopes of a rising generation.

" The manner of her building the cell is this: In the hinder part of her body, nature has provided her with a round smooth instrument, eight lines in length, which at its head is as big as a writing quill, diminishing to a hard sharp point, hollow within like the tooth of a viper, but only to be seen with a lens. At the root of this vehicle there is a cavity, with a kind of bladder containing a glutinous matter of the same colour but without the consistency or tenacity of that of the silk-worm, as I found by an experiment, made for the purpose, by an infusion in vinegar, for several days, without any effect. The orifice of the bladder corresponds exactly with the instrument which serves to eject the glutinous matter. It is hid under the skin of the belly, and its interior surface is united to the moveable parts of the belly, and can partake of its motions, forming the most admirable contexture for every part of its operations, as she can dispose of this ingredient at pleasure, and eject the fluid, which has three very essential properties: first, being indissoluble in water, it prevents the young from being drowned; next, it resists the heat of the sun, otherwise the structure would give way and destroy its inhabitants; lastly, it is proof against the frost of winter, so as to preserve a necessary warmth within. For greater security, this retreat is always contrived in a solitary place: for though a million of locusts were to light upon a cultivated field, not one would deposit her eggs there; but wherever they meet a barren and lonesome situation, they are sure to repair to it to lay their eggs."

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* Barrow's Travels, p. 257.

One would imagine that so horrid an insect as the locust would never be thought of as food for man; and yet it is an undoubted fact, that in several parts of Africa the people eat them. They are dressed in different ways; some pound and boil them with milk; others only broil them on the coals, and think them excellent food. "There is no disputing about tastes (says Mr. Adanson): for my part, I would willingly resign whole clouds of locusts to the negroes of Gambia, for the meanest of their fishes*."

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* Adanson's Voyage to Senegal.

THE LANTERN-FLIES.

In this tribe, the head is extended forward, and is hollow and inflated. The antennæ, consisting of two joints, the outer one of which is globular, are seated below the eyes. The rostrum or beak* is four-jointed, and inflected or bent inwards under the body. The legs are not formed for leaping.

THE GREAT LANTERN-FLY†.

This is the most vivid of all the luminous insects. It affords a light so great, that travellers walking by night are said to be enabled to pursue their journey with sufficient certainty, by one or two of them tied to a stick, and carried in the manner of a torch. It is common in many parts of South America, and is described by Madam Merian in her superb work on the insects of Surinam. She gives an entertaining account of the alarm into which she was thrown by the flashing which proceeded from them in the dark, before she had been apprized of their shining nature.

" The Indians once brought me (says she), before I knew that they shone by night, a number of these Lantern-flies, which I shut up in a large wooden box. In the night they made such a noise that I awoke in a fright, and ordered a light to be brought, not being able to guess from whence the noise proceeded: as soon as I found that it came from the box, I opened it, but was still more alarmed, and let it fall to the ground in my fright, at seeing a flame of fire come out of it; and as many animals as came out, so many different flames appeared. When I found this to be the case, I recovered from my alarm, and again collected the insects, much admiring their splendid appearance." The light, she adds, of one of these insects is sufficiently bright that a person may see to read a news-paper by it*.

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* This is a jointed sheath, situated in the mouth, and containing setæ or bristles, used in extracting juices for food, and for some other purposes.

† Fulgora lanternaria. *Linn.*

The light emitted by this Fire-fly proceeds entirely from the hollow part, or lantern, of the head; no other part of the animal being luminous†. Dr. Darwin conjectures that the use of this light is merely to prevent the insects from flying against objects in the night, and to enable them to procure their sustenance in the dark. He seems however not to have considered, that very few of the numerous train of night-insects are possessed of this luminous property, and yet all the functions of these are performed with perfect regularity. Its most essential use is no doubt, as in the other luminous tribes, to point out the sexes to each other, serving in them the same purpose, in this respect, as the voice in the larger animals.

The head in this species is large, and somewhat oval. The wings are variegated; and the lower pair is marked each with a large ocellated or eye-like spot. Sometimes the insect is seen of three or four inches in length.

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* Merian's Surinam, tab. 49. † Shaw's Nat. Mis. i. tab. 37.

THE CICADÆ.

These insects are found in various parts both of the new and old continent, where they subsist almost wholly on the leaves of trees and other vegetable substances. They are furnished with a hard and horny proboscis or tube in which is contained a very slender sucking pipe. The former is not much unlike a gimlet in form, and is used by them in boring through the bark of trees for the purpose of extracting their juices. With this proboscis they also bore holes in the small and tender twigs of the exterior branches, in which they deposit their eggs sometimes to the amount of six or seven hundred. Each cell does not contain more than from twelve to twenty, so that by this means they often do much damage to the trees which they frequent.

The chrysalids of these insects are not torpid, as in many others, but have six legs, and differ from the parent in having only the rudiments of wings. They are exceedingly active, and in general run and leap about upon the trees with great sprightliness.

The males of the perfect insects make a chirping noise, of use in alluring the females. Some naturalists suppose that this noise is caused by the flapping of the lamellæ against the abdomen: others by the rustling of the segments of the body in the contractile motion of that part; and Beckmann, that it is caused by the beating of the body and legs against the wings. The lamellæ on examination do not appear to have sufficient freedom of motion to produce such a sound.

Those of the hottest climates make the loudest noise. From the papers of Mr. Smeathman, who resided a considerable time in Africa, it appears that some are so loud as to be heard to the distance of half a mile; and that the singing of one of them in a room will immediately silence a whole company. Professor Thunberg says, that one of the Javanese species makes a noise as shrill and piercing as if it proceeded from a trumpet.

Several of the species were known to the antients, who made them the emblems of eternal youth. They deemed them creatures beloved both by Gods and men; and indulged many poetical fictions concerning them, but particularly that they subsisted only on dew. The Athenians wore golden Cicadæ in their hair to denote their national antiquity, or that like these creatures they were the first-born of the earth. Anacreon, addreſſing one of them, depicts in glowing colours the felicity that they were universally supposed to enjoy.

Happy creature! What below
Can more happy live than thou?
Seated on thy leafy throne,
(Summer weaves the verdant crown)

Sipping o'er the pearly lawn
The fragrant nectar of the dawn;
Little tales thou lov'st to sing,
Tales of mirth—an insect king.
Thine the treasures of the field,
All thy own the seasons yield;
Nature paints thee for the year,
Songster to the shepherds dear:
Innocent, of placid fame,
What of man can boast the same?
Thine the lavish'd voice of praise,
Harbinger of fruitful days;
Darling of the tuneful Nine,
Phœbus is thy sire divine;
Phœbus to thy notes has giv'n
Music from the spheres of heav'n;
Happy most, as first of earth,
All thy hours are peace and mirth;
Cares nor pains to thee belong,
Thou alone art ever young;
Thine the pure immortal vein,
Blood nor flesh thy life sustain;
Rich in spirits, health thy feast,
Thou'rt a demi-god at least.

The Cicadæ have an inflected rostrum, bristle-shaped antennæ. The wing-cases are m branaceous, and decline along the sides of the b Their legs are in general formed for leaping.

THE WAX-FORMING CICADA*.

This is a singular insect, and deserving of s attention both as an object of curiosity and fron importance in domestic economy. It is found both in the countries of the East and in America. Its wing-cases are green, margined with red, and deflexed; and the interior ones spotted with black. In the variety figured and described by Sir George Staunton, these are whitish, margined with black, and have a row of black spots on the posterior edge.

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* Cicada limbata.

The larvæ are elegant and beautiful creatures, and to their labours the Chinese are indebted for the fine white wax that is so much esteemed in the East-Indies. They form a sort of white grease which attaches to the branches of trees, hardens there, and becomes wax. It is scraped off in the autumn, melted on the fire, and strained: it is then poured into cold water, where it coagulates and forms into cakes. In appearance it is white and glossy, and mixed with oil is used to make candles, for which purpose it is thought greatly superior to bees-wax.

The insects are white when young, and it is then that they make their wax. When old, they are of a blackish chesnut colour, and form little pelotons on the branches of trees. These at first are each of the size of a grain of millet; towards the beginning of the spring they increase in bulk and spread; they are attached to the branches like grapes, and, at first sight, the trees that bear them appear loaded with fruit. About the beginning of May the inhabitants gather them, and, having enveloped them in the leaves of a species of broad-leaved grass, suspend them to the trees. At the end of June, and in July, the pelotons open, and the insects come forth, crawl about the leaves, and form their wax.

Sir George Staunton says of these insects, that he saw them busily employed upon the small branches of a shrub, that in its general habit had a considerable resemblance to privet. They did not much exceed the size of the domestic fly, and were of a very singular structure. They were in every part covered with a kind of white powder: and the branches they most frequented were entirely whitened by this substance, strewed upon them.

THE AMERICAN LOCUST*.

This species of Cicadæ is at all times very common in Pennsylvania, but at certain periods (generally of fourteen or fifteen years) the numbers are so immense that they have obtained the general appellation of Locusts.

Towards the end of April they emerge from the ground; and their appearance is always to be predicted by the swine searching for them. The swarms are sometimes so great, that, in the places from whence they have arisen, the earth appears almost as full of holes as a honey-comb. They always leave the ground during the night. On their first coming out, they are in their pupa state; but very soon afterwards the back bursts, and the flying insects disengage themselves from their case. For a little while they are entirely white, with red eyes, and seem very weak and tender; but by the next day they attain their full strength and perfection, being of a dark brown colour, with four finely varied, transparent wings.

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* Cicada septendecim. *Linn.*

They are very active, flying about from tree to tree with great agility. The female is directed to the male by the loud chirping noise that he has, in common with others of the Cicadæ. She lays her eggs about the latter end of May, piercing for this purpose the tender twigs of trees with the dart from her tail. With this she is able to penetrate the wood in a surprizingly expeditious manner, crowding it for the length of two or three inches full of eggs, ranged in close lines, with from twelve to eighteen in each. She always darts to the pith of the branch, in order that the insect when it proceeds from the egg may find food proper for its tender state. When mature the young creep forth, drop off, and make their way into the ground to prepare for a change. Here they are sometimes found at the depth of two feet or upwards.

For the sake of experiment, some of the eggs of this species about the usual time of hatching were taken out, and spread upon a table. In about an hour they cracked, and it was very entertaining to observe how the little insects contrived to disengage themselves from the shell. When they had got clear from all incumbrances, they ran about very briskly, evidently searching for a repository in the earth *.

Very shortly after attaining their perfect state they are to be found spread over the country for many miles round. They are excessively voracious, and do

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* Phil. Tran. vol. liv. p. 65. tab. 8.

infinite damage in their periodical swarmings to both orchard and forest trees: and were it not for the number and variety of their enemies, and the naturally short duration of their lives, the inhabitants would often suffer from them all the horrors of famine. It seems to have been of these insects that Mr. Hughes says such vast swarms were bred or came into the island of Barbadoes in the year 1734-5, that they destroyed almost every green and tender plant. So great was the destruction that they caused, especially among the potatoe vines, on whose roots the poor people chiefly subsisted, and such the scarcity of food occasioned by them, particularly in the parish of St. Philip, that a collection was made for these sufferers through the rest of the island*.

Domestic fowls are fond of them; and even some of the American squirrels become fat with them at the times when they are very abundant. The Indians also pluck off their wings and boil the bodies for food.—It is said that they may be kept from the trees by suspending on the branches pieces of tow impregnated with a mixture of brimstone and train oil.

THE BLACK-HEADED FROGHOPPER †.

The larvæ or grubs of this insect discharge from their bodies upon the branches and leaves of plants a kind of frothy matter (called by the country people in many parts of England Cuckoo-spit), in the midst of which they constantly reside, probably for shelter against the rapacity of such stronger insects as would otherwise prey upon them. Nature has afforded this kind of defence to the insects, as their naked and soft bodies might otherwise very easily be injured; perhaps also the moisture of this foam may serve to screen them from the sultry beams of the sun. On removing the foam the grub is discovered underneath; but it will not remain long uncovered. It soon emits fresh foam that again hides it from the eye of observation. It is in the midst of this foam that the larva goes through its metamorphosis to a chrysalis, and a winged insect. This may be observed by any person who is careful enough to watch when the froth begins a little to subside. At this time he must put the insect with its leaf under a glass. The froth degenerating to a white film fixes the creature to the leaf: soon after this the fly may be seen first putting out its head, and afterwards by degrees its body. As soon as the fore-part is out, a small protuberance will be perceived on each side, which every moment growing larger, will soon appear to be the wings of the fly unfolding by degrees. In about a quarter of an hour the whole change is completed, the fly is liberated, its wings are extended over its body, and the fine silver-like case of the larva, with all its legs and other apparatus, will be seen left behind.

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* Natural History of Barbadoes.

† Synonyms.—Cicada spumaria. *Linn.*——Cuckoo-spit or Froth-worm.

The perfect insect is of a brown colour, and has on the upper wings two lateral whitish spots. It is very common in meadows, &c. and is so agile that when attempted to be caught it will sometimes spring to the distance of two or three yards.

THE CIMICES.

The rostrum of the Cimices or Bugs is inflected; and the antennæ are longer than the thorax. They have four wings folded cross-wise, the upper ones coriaceous on the upper part. The back is flat; and the legs are formed for running.

The larvæ differ from the perfect insects, in little else than the want of wings. Many of them infest plants, on which they live, and in which they lay their eggs. Several of the species are voracious, and spare scarcely any other insects that they can conquer. They glut themselves with the blood of animals; destroy caterpillars, flies, and even beetles, the hardness of whose elytra would seem to be proof against all their attacks; the incautious naturalist may also himself sometimes experience the severity of their nature.

THE BED BUG*.

The Bed Bug, which is a nauseous and troublesome inhabitant of most houses in large towns, is singular in having neither wings nor wing-cases.

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* Cimex lectularius. *Linn.*

It runs about with considerable activity in the night, to suck the blood of persons that are asleep, hiding itself by day in crevices and other retired places.

It is supposed to have been first introduced to this country in the fir timber that was brought over to rebuild London after it had suffered by the great fire; for it is generally said that Bugs were not known in England before that time, and many of them were found almost immediately afterwards in the new-built houses.

Their most favourite food is blood, dried paste, size, deal, beach, osier and some other kinds of timber, the sap of which they suck; and on any of these they are able to exist. They will not feed on oak, walnut, cedar or mahogany; for several pairs that, for the sake of experiment, were confined with these kinds of wood, soon died, whilst those kept with the others continued to thrive through the whole year.

The female generally lays about fifty eggs at a time, which are white, and, when protruded, are covered with a viscous matter, which, afterwards hardening, sticks them firmly to the place where they are deposited. These are usually hatched in about three weeks. The first time of laying is in March, the others in May, July and September: so that, from every female bug that outlives the season, as many as two hundred young may be produced. Thus is the excessive increase of these nauseous animals to be accounted for, where proper care is not taken in destroying them.

The young are, for some time after they first escape from the egg, perfectly white, but they generally become brown in the course of about three weeks. In eleven weeks they are at full growth. They are then very watchful and cunning creatures; and so fierce among their own species, that they will sometimes contend with the utmost fury; and in their combats they seldom leave off till either one or both of the animals are killed. Spiders are very fond of them, and often seize them for food.

In order to clear a house of Bugs the leading point is cleanliness in every respect, for this is their greatest annoyance, and by this alone their increase is to be materially checked. The first young begin to burst from the eggs early in spring, frequently even in February. At this season it is that the greatest attention is required. The bed infested by them ought to be stripped of all its furniture, which should be washed, and if linen even boiled, or if stuff hot-pressed. The bedstead should be taken in pieces, and dusted, and washed with spirits of wine in all the joints and crevices, for it is in these parts principally that the females deposit their eggs. This done, all the cavities, &c. should be well filled with the best soft soap, mixed up with verdigrease and Scotch snuff. On this composition the young will immediately feed, after leaving the egg, (if any escape the cleansing,) and will be destroyed, as will also such of the old ones as happen to be left.

Bugs abound in all the hot climates, from whence most of our merchant vessels are over-run with them. This accounts for their extreme numbers in all the sea-port towns of this country, and particularly in the metropolis; being conveyed thither in clothes, packages, &c. Hence appears the great necessity of examining carefully every thing brought from such vessels into the houses.

Deal and beech boards should by all means be removed, as should also every thing that is fixed to a bed by means of paste, as these afford them both shelter and food. Oak and mahogany are probably the best kinds of wood to use, as the closeness of their texture allows the animals but an uncomfortable situation.

It is supposed that Bugs do not altogether lie torpid during the winter, but that in the cold weather they require less nutriment, and therefore that they are not tempted to come so often out of their retreats.

CIMEX PARADOXUS.

"That singular insect the Cimex Paradoxus, which," says Dr. Sparrman, "I have described, and of which I have given a drawing in the Swedish Transactions, I discovered at this place (the Cape of Good Hope) as at noon-tide I sought for shelter among the branches of a shrub, from the intolerable heat of the sun. Though the air was now extremely still and calm, so as hardly to have shaken an aspen leaf, yet I thought I saw a little withered, pale, crumpled leaf, eaten as it were by caterpillars, flitting from the tree. This appeared to me so very extraordinary, that I thought it worth while suddenly to quit my verdant bower in order to contemplate it; and I could scarcely believe my eyes, when I saw a live insect, in shape and colour resembling the fragment of a withered leaf, with the edges turned up and eaten away, as it were, by caterpillars, and at the same time all over beset with prickles. Nature, by this peculiar form, has certainly extremely well defended, and concealed, as it were in a mask, this insect from birds and its other diminutive foes; in all probability with a view to its preservation, and to employ it for some important office in the system of her economy; a system with which we are too little acquainted, in general too little investigate, and, in every part of it, can never sufficiently admire with that respect and adoration which we owe to the great author of nature and ruler of the universe*."

THE APHIDES.

The minute animals that compose this singular tribe infest various plants, and often in numbers so great, as to consume their juices and prevent their growth. They are sometimes winged, and sometimes destitute of wings, without any distinction of sex. In the spring they are viviparous, producing the young alive; and in the autumn they are oviparous, depositing their eggs, like most other insects, in places where they remain secured through the winter till the ensuing spring, when they are hatched. In these insects we have also another surprising deviation from the general laws of nature, in one impregnation of the female being sufficient for nine generations, without any further assistance of the male.

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* Voyage to the Cape of Good Hope.

Their rostrum, the sheath of which is composed of five joints, is inflected. The antennæ are tapering, and longer than the thorax. They have either four wings, or are entirely destitute of them. At the abdomen are two obtuse erect horns; and the tail is sometimes terminated by a small style.

The larvæ, chrysalids and perfect insects cannot be distinguished.

THE ROSE APHIS*.

This insect, which is well known by the name of *Roſe-louſe*, is generally of a green colour; with the tip of the antennæ and horns black. The tail is pointed and without a style.

Towards the beginning of February if the weather is sufficiently warm to make the buds of the rose-tree swell and appear green, these species of Aphis will be found on them in considerable abundance. They are now produced from small black oval eggs which were deposited in autumn on the last year's shoots. If after their appearance the weather becomes cold, almost the whole of them suffer, and the trees are, for that year, in a great measure freed from them.

Those that withstand the severity of the weather seldom arrive at their full growth before April, when, after twice casting their skins, they usually begin to breed. It then appears that they are *all females*, and each of them produces a very numerous progeny, and that without any intercourse with a male insect.— These, though themselves produced from eggs, are viviparous. Their young when they first come from the parent insects are each enveloped in a thin membrane that has the appearance of an oval egg. This apparent egg adheres by one extremity to the mother, while the young Aphis proceeding from it extends the other, by this means gradually drawing the ruptured membrane over the head and body to the hind feet. During the operation, and for some time afterwards, the forepart of the head adheres by the viscous matter about it to the tail of the parent. Thus suspended it soon entirely frees itself from its former envelopment; and when its limbs become a little strengthened, it is set down on some tender shoot, and there left to provide for itself.

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* Aphis Rosæ. *Linn.* Gmel.

In the spring months there appear but these two generations of the Aphis: the warmth of summer however produces no less than five. One of these appears in May, and the months of June and July supply each two more. The insects of the May breed cast their skins twice, and the others three or four times according to the warmth of the season. When the heat has been sufficiently great and the food in tolerable plenty, the first change has been observed to take place in about ten days after their production.

Early in June some of the third generation, which were produced about the middle of May, after casting their last covering discover four erect wings much longer than their bodies. The formation of the wings seems to depend not on sexual distinction, nor even on the original structure of the insects, so much as on the quantity and quality of the nourishment with which they are supplied. Few of those on succulent shoots have wings, while those of the same generation on the less tender branches are most of them winged. Some time before they come to their full growth, it is easy to discern which of them will have wings, from a remarkable fullness of the breast. When the last covering is rejected, the wings, which were before folded in a very narrow compass, gradually extend in a most beautiful manner to their proper size and dimensions. All the following breeds are winged.

In the autumn the eighth, ninth, and tenth generations are produced, two in August, and the last about the middle of September. The two first resemble the summer breeds, but the third differs very greatly from all the rest. Although all the Aphides which have hitherto appeared have been females, in this tenth generation several *male* insects are found. The females have at first the appearance of the summer insects; but in a few days their colour changes from green to yellow, and gradually, before their full growth, to orange. These yellow females are destitute of wings. The males, when they first appear, are of a reddish brown, but have afterwards, when they begin to thicken about the breast, a dark line along the middle of the back. They come to their full growth in about three weeks, and then casting their last skin appear in every part except the wings of a bright yellow. They soon however become dark brown. The wings become transparent, and at length are in appearance not unlike very fine black gauze. The females very soon begin to deposit their eggs, which, if possible, is always done near the buds of the branches, that the future young may be the more easily supplied with nourishment. Some of them continue laying their eggs till the beginning of November: these are oval, and when first protruded are green, but they soon become perfectly black. They adhere to the branches on which they are deposited, by the viscous matter that at first surrounds them. These eggs remain through the winter till the ensuing spring before they are hatched.

If these insects had not many enemies, their increase in summer would be so great as, by wounding and exhausting the tender shoots of the trees, sometimes to suppress their vegetation. Among their enemies one of the principal is a small black species of Ichneumon fly* with a slender body and long antennæ, which darts its pointed tail into the bodies of the Aphides, and at the same time deposits in each an egg. This egg afterwards produces a worm, which feeds on the body of the insect till it has acquired its full growth, when it undergoes its change, and entirely destroys this its nidus.

After a mild spring most of the species of Aphis become so numerous as to do considerable injury to the trees on which they are found. The best mode of remedying this evil is to lop off the infected shoots before the insects are greatly multiplied, repeating the same operation before the time that the eggs are deposited. By the first pruning a very numerous present increase will be prevented, and by the second, the following year's supply may in a great measure be cut off*.

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* The Ichneumon Aphidum of Linnæus.

THE COCHINEAL INSECTS.

These are an extremely fertile race, and many of them are very troublesome in stoves and greenhouses. The females fix themselves and adhere almost immoveably to the roots, and sometimes to the branches of plants. Some of them, having thus fixed themselves, lose entirely the form and appearance of insects; their bodies swell, their skin stretches and becomes smooth, and they so much resemble some of the galls or excrescences found on plants as often to be mistaken for such. After this change the abdomen serves only as a kind of shell or covering under which the eggs are concealed. Others, though they are likewise thus fixed, preserve the form of insects till they have laid their eggs and perish.

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* Richardson on Aphides. Phil. Tran. vol. lxi. p. 182.

A kind of down or cotton grows out of their belly, which serves to make the nest in which they deposit their eggs.—Most of the species found in our hot-houses have been brought over with exotic plants from other climates.

The rostrum or trunk is seated on the breast; and the antennæ are thread-shaped, or of equal thickness throughout. The abdomen is terminated by four or six light-coloured bristles. The male has two erect wings, but the females have none.

THE LAC COCHINEAL*.

The head and trunk of this insect seem to form one uniform, oval, compressed red body, somewhat of the shape and size of a very small louse, consisting of twelve transverse rings. The back is keel-shaped, and the belly flat. The antennæ are half the length of the body, filiform, and diverging, sending off two and sometimes three diverging hairs. The tail is a little white point, from whence proceed two horizontal hairs as long as the body.

Mr. Kerr, who has given a minute account of these insects in the Philosophical Transactions, says that he has often observed their birth, but could never see any of them with wings, nor was he ever able to remark any distinction in the sexes: owing, he confesses, most probably to the minuteness of the objects, and the want of proper glasses.

They are produced from the womb of the parent in the months of November and December. For some time they traverse the branches of the trees upon which they were produced, and then fix themselves on the succulent extremities of the young shoots. By the middle of January they are all fixed in their proper situations, and, though they now show no marks of life, appear as plump as before. The limbs, antennæ and bristles of the tail are no longer to be seen. Around their edges they are environed with a sub-pellucid gelatinous liquid, which seems to glue them to the branch. The gradual accumulation of this liquid at length forms a complete cell for the insect, which takes place about the middle of March. The insect is now, in appearance, an oval smooth red bag, without life, about the size of a small American Cochineal insect, emarginated at the obtuse end, and full of a beautiful red liquid.

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* Coccus Ficûs, *Linn.*

In October and November twenty or thirty small oval eggs, or rather young grubs, are to be found within the red fluid of the mother. When this fluid is all consumed the young insects pierce a hole through the external covering, and walk off one by one, leaving their nidus behind. This nidus is that white membranaceous substance found in the empty shells of the Stick Lac.

These insects are found on only four different kinds of trees, the principal of which are the Ficus religiosa and Ficus Indica of Linnæus.

They generally fix themselves in such numbers and so close to each other, that scarcely more than one female in six has room to complete her cell: the others die, and become the food of various insects. The extreme branches of the above trees appear as if they were covered with a red dust, and their sap is frequently so much exhausted that the adjoining parts wither away.—The sap of the trees seems much allied to the cell of the Coccus, so that it appears to have undergone very little change by its formation into these shells.

These insects, which in the East Indies have the name of Gum Lac, are principally found on the trees of the uncultivated mountains on both sides of the Ganges, where nature has been so bountiful, that, were the consumption many times greater than it now is, the markets would be fully supplied. The only trouble is in breaking down the branches and carrying them to market.

The price in the year 1781 of Gum Lac in Dacca was only twelve shillings for the hundred pounds weight, notwithstanding its being brought from a very great distance, as the greatest part of it is collected in Assam. The best Lac is of a deep red colour. If it is pale, and pierced at the top, the value diminishes, because the insects have left their cells, and consequently it can be of no use as a dye; though probably it may be of more value as a varnish.

Stick Lac is the natural state. When the cells are separated from the sticks, broken into small pieces, and appear in a granulated form, they are called *Seed Lac*. This liquefied by fire and formed into cakes is *Lump Lac*. When the cells are liquefied, strained, and formed into thin transparent laminæ, the substance has the name of *Shell Lac*.

Of the Shell Lac the natives of the Eastern countries make ornamental rings, to decorate the arms of the females. They also form it into beads, necklaces, and other female ornaments.

This substance was formerly used in medicine; but it is now confined principally to the making of sealing-wax, and to japanning, painting, and dyeing*.

THE AMERICAN COCHINEAL †.

This Cochineal, so useful, when properly prepared, to painters and dyers, is a native of South America, where it is found on several species of Cactus, particularly the Cactus Opuntia, or Prickly Pear-tree. In Jamaica these insects are also now pretty common, but they are generally understood to have been introduced from America. The heavy rains, however, that the West India islands are subject to, render the industry of the natives in breeding and rearing them frequently fruitless.

The Cochineal made at the Brazils was observed by Mr. Barrow, one of the gentlemen who attended the late Embassy to China, to be produced from an insect somewhat differing from the *Coccus Cacti* of Linnæus. "The insect of Rio (says this gentleman) is convex, with legs of a clear bright red, in both male and female, and the antennæ moniliform or bead-like. The male is a delicate and beautiful insect, the colour of the whole body a bright red, nearly resembling the pigment usually called red lake. The breast is elliptical, and slightly attached to the head. The antennæ are about half the length of the body. The legs are of a more brilliant red than that of the other parts. Two fine white filaments, about three times the length of the insect, project from its belly or abdomen. The wings are two, erect, of a faint straw colour, and of a very delicate texture. The female has no wings, is elliptic in its form, and convex on both sides, but chiefly so on the back, which is covered with a white downy substance resembling the finest cotton. The abdomen is marked with transverse rugæ or furrows. The mouth is situated in the breast, having a brown beak, inclining to a purple tint, that penetrates the plant on which the insect feeds. Its six legs are of a clear bright red."

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* Phil. Tran. vol. lxxi. p. 374.

† Coccus Cacti. *Linn.*

When the young insects are arrived at their full growth they adhere to the leaf of the Cactus in a torpid state; and it is at this period that they are taken from the plant for use. "Twice or thrice a week the slaves appropriated to this employment go among the Cactus plants, and pick off carefully, with a bamboo twig shaped somewhat into the form of a pen, every full-grown insect they can find, with many not yet arrived to their perfect state; the consequence of which is, that the plants are never b[illegible] stocked with insects, many of the females being destroyed before they had deposited their young. Th natives of Mexico pursue a method very differen As soon as the periodical rains are over, and the we ther is warmer, as well as drier, they fix on th prickles of the Cactus leaves small parcels of th finest moss, serving as nests to contain each ten a dozen full-grown female insects. These, in the course of a few days, bring forth an innumerable tribe of young, spreading themselves over the leaves and branches of the plant, till they become attached to those spots which they find most favourable for supplying nutritious juice; where, soon acquiring their full growth, they remain motionless, and then are gathered off for use; a sufficient number being always left for the production of new broods.

"The insects are soon converted into cochineal by a very simple process;—but if, *in corporeal sufferance, the poor beetle feels a pang as great as when a giant dies*, this process is not more simple than it is cruel. The insects, which were collected in a wooden bowl, are thickly spread from thence upon a flat dish of earthenware, and placed alive over a charcoal fire, where they are slowly roasted until the downy covering disappears, and the aqueous juices of the animal are totally evaporated. During this operation, the insects are continually stirred about with a tin ladle, and sometimes water is sprinkled upon them, to prevent absolute torrefaction, which would destroy the colour, and reduce the insect to a coal; but a little habit teaches when to remove them from the fire. They then appear like so many dark, round, reddish grains, and take the name of cochineal, preserving so little the original form of the insect, that this precious dye was long known and sought in Europe before naturalists had determined whether it was an animal, vegetable, or mineral substance."

It seems by no means improbable that a Cochineal more pure than what is produced from the insect, might be prepared from some of the plants on which it feeds. There is also no reason for supposing that we might not also prepare it from our English species, which bear a great resemblance to those of America, if only a proper and judicious management was adopted.

It has been computed, that there are imported into Europe, in the course of trade, no less than eight hundred and eighty thousand pounds weight of cochineal annually.

THE EUROPEAN COCHINEAL*.

This species of Cochineal is among the various and valuable productions with which the beneficent hand of nature has enriched the dominions of Spain. Like the rest of the genus, it is found sticking to the branches and leaves of trees, particularly to those of a small species of oak about two feet high, the Quercus coccifera of Linnæus, that grows in Spain, Provence, Languedoc, and along the shores of the Mediterranean.

In the month of March it is to be seen in its first state no bigger than a grain of millet, fixed to the tree and scarcely able to crawl. It soon becomes immoveable: at this period it increases very much in size. It now bears considerable resemblance to a vegetable excrescence, being covered over with a down that adheres on all sides to the tree. Its figure is not unlike that of a small sloe. Its growth is completed in April, when it attains a round shape, and is about the size of a pea, of a reddish colour, and appearing as if filled with discoloured blood. Towards the end of May it is seen to be full of eggs ranged under the belly in the down that covers its body. After laying its eggs here it soon dies, adhering still to its position, and rendering to its progeny a further service by shielding them from the inclemency of the weather or the hostile attacks of other insects. Each of the females will sometimes produce so many as two thousand young.

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* SYNONYMS.—Coccus Ilicis. *Linn.*——Grana Kermes. Scarlet Grain. *Dillon.*

The poor people of many of the provinces obtain a subsistence by collecting these insects for sale; and in order to pick them off the branches with greater facility, many of them suffer the nails of their fingers to grow to a great length. In some years a sum amounting to little less than thirty thousand dollars (five thousand pounds sterling) has been produced to the inhabitants of one district in Spain from the sale of this insect. But being used only as an ingredient in dyeing purple, it has been much neglected since the introduction of the American Cochineal *.

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* Dillon, 18.

LEPIDOPTEROUS INSECTS*.

THE present order contains only three tribes, the Butterflies, Moths, and Hawk-Moths. These are all produced from Caterpillars, by a change that is common to all the insect species. The caterpillars proceed from eggs; and those of the Butterflies in particular are so numerous, that in the spring of the year the leaves and tenderest stems of plants are sometimes perfectly crowded with them.

Their bodies are composed in general of twelve membranaceous rings, which sufficiently distinguish them from all such reptiles as bear the least resemblance to them. Their head is scarcely to be distinguished from the body but by its containing an opening, in which are two jaws, each armed with a very large and thick tooth. The number of their feet varies with their size and form. Along the sides are arranged holes or tracheæ through which they breathe.

Caterpillars are in general extremely voracious, some of them eating more than double their own weight in a day, without suffering any inconvenience from it; for the digestive powers of all animals are proportioned not so much to their size as to the duration of their lives.

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* This is the third of the Linnean orders of insects.

They often change their skin without materially altering their shape, till at last they put on one very different from all the rest. In this state they have the name of Aurelia or Chrysalis; and in it all the parts of their future form are visible, but so very soft and delicate, that the least touch discomposes them. Though dormant and entirely helpless, all their members are now completely formed, and they only wait the acquisition of a shell to defend them from external injuries, and suffer them to commence their flight.

The production and manners of these, in this state, imperfect animals afford much matter both for amusement and instruction. We cannot therefore dismiss the subject, without descending a little into the history of the manners of some of the species.

About the middle of summer a butterfly deposits from three to four hundred eggs on the leaf of a tree, from each of which, in a few days, a young caterpillar proceeds. The eggs are no sooner hatched, than the young begin to form a common habitation. They spin silken threads, which they attach to one edge of the leaf, and extend to the other. By this operation, they make the two edges of the leaf approach each other, and form a cavity resembling a hammock. In a short time the concave leaf is completely roofed with a covering of silk. Under this tent the animals live together in mutual friendship and harmony. When not disposed to eat or to spin, they retire into their tent. It requires several of these habitations to contain the whole. According as the animals increase in size, the number of their tents is augmented.

But these are only temporary and partial lodgments, constructed for mutual convenience, till the caterpillars are in a condition to build one more spacious, which will be sufficient to contain the whole. After gnawing one half of the substance of such leaves as happen to be near the end of some twig or small branch, they begin their great work. In constructing this new edifice, or net, the caterpillars encrust a considerable part of the twig with white silk. In the same manner they cover two or three of such leaves as are nearest to the termination of the twig. They then spin silken coverings of greater dimensions, in which they inclose the two or three leaves, together with the twig. The nest is now so spacious, that it is able to contain the whole community, every individual of which is employed in the common labour. These nests are too frequently seen in autumn upon the fruit-trees of our gardens. They are still more exposed to observation in winter, when the leaves which formerly concealed many of them are fallen. They consist of large bundles of white silk and withered leaves, without any regular or constant form. Some of them are flat, others roundish; but none of them are destitute of angles. By different plain coverings extended from the opposite sides of leaves and of the twig, the internal part of the nest is divided into a number of different apartments. To each of these, which seem to be very irregular, there are passages by which the caterpillars can either go out in quest of food, or retire in the evening, or during rainy weather. The silken coverings, by repeated layers, become at last so thick and strong, that they resist all the attacks of the wind, and all the injuries of the air, during eight or nine months.

About the beginning of October, or when the frost commences, the whole community shut themselves up in the nest. During the winter they remain immoveable, and seemingly dead; but, when exposed to heat, they soon discover symptoms of life, and begin to creep. In this country, they seldom go out of the nest till the middle or end of April. When they shut themselves up for the winter, they are very small; but, after they have fed for some days in spring upon the young and tender leaves, they find the nest itself, and all the entrances to it, too small for the increased size of their bodies. To remedy this inconvenience, these creatures know how to enlarge both the nest and its passages, by additional operations accommodated to their present state. Into these new lodgings they retire when they want to repose, to screen themselves from the injuries of the weather, or to cast their skins. In fine, after casting their skins several times, the time of their dispersion arrives. From the beginning to near the end of June, they lead a solitary life. Their social disposition is no longer felt. Each of them spins a pod of coarse brownish silk. In a few days they are changed into chrysalids, and in eighteen or twenty days more are transformed into butterflies.

The modes adopted by caterpillars to screen themselves from observation are as various as they are interesting and curious. Many of them feed enclosed within the stems of herbaceous plants;

others in the branches or trunks of trees; a few within fruits and the buds of flowers; some on the roots of plants; others again float on the surface of the water, between the leaves of aquatic vegetables, woven around them with inimitable art; and a very great number escape our notice, by taking their nourishment only in the night. And though many feed on the leaves of plants and trees in the day-time, yet some, as if conscious of the similarity of their colour to that of the undersides of the leaves, and of the safety they derive from attaching themselves thereto, are seldom to be seen but in that situation. Many of the moths whose colours bear resemblance to those of the trunks or branches of trees, frequently fix themselves there and remain motionless for several hours together. In these situations, a person unaccustomed to them would not hesitate to pronounce them, from a little distance, the mere rugosities of the bark.

These various modes of eluding our sight, added to the uncertainty of breeding many species when procured, have prevented our being acquainted with the larvæ of the far greater part of the lepidopterous insects.

THE BUTTERFLY TRIBE.

THESE elegant insects feed on the nectar of flowers, and the moisture exuding from plants and trees, which they extract by means of their long proboscis or tongue. Their caterpillars are sometimes smooth, and sometimes thickly covered with hair; and their chrysalids are naked, quiescent, and attached to trees or other substances, by filaments proceeding either from the tip or the middle of their bodies.

Their antennæ become thicker towards the tip than in any other part, and generally end in a knob. The wings when at rest are erect, the upper edges meeting together over the body. They are entirely diurnal animals.

THE LARGE GARDEN WHITE BUTTERFLY*.

This is a common species, and often, in its caterpillar state, very destructive to our cabbage and cauliflower plants. The caterpillars seem almost confined to these plants, on which they are generally to be found in great numbers from June to October. The Butterflies first appear on wing in the middle of May, and about the end of the same month lay their eggs in clusters on the under sides of cabbage leaves. In a few days after the caterpillars come forth; and continue to feed together till the end of June, when they are at their full growth. They then traverse about in search of convenient places to fix themselves under, where also, after their change, the chrysalids may be sheltered. When such are found, they each fix their tail by a web, and carry a strong thread of the same round their body near the head; and, thus firmly secured, hang a few hours, when the chrysalis becomes perfectly formed, and divested of the caterpillar's skin. In fourteen days after this the fly is on the wing. The caterpillars of this latter brood arrive at full growth and change to chrysalids in September, in which state they remain through the winter till the beginning of the following May. During this time we often see them hanging under the copings of garden walls, under pales, and in other places where they can have tolerable shelter from the inclemency of the weather.

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* *Papilio Brassicæ.—Linn.*

The general colour of this Butterfly is white, but the male differs from the female in having a few dark spots on his wings *.

THE MARSH FRITTILARY †.

The Marsh Frittilary is a small Butterfly not more than an inch and a half across the broadest part of its expanded wings. Its colour is a brownish orange, variegated with yellow and black, in a small pattern. The under sides of the wings are lighter, and chiefly orange and yellow. It is sometimes called Greasy or Dishclout Frittilary, from these under sides having always a greasy appearance.

The caterpillars are to be seen in some particular situations in September in great abundance. They keep together under the cover of a fine web, which they spin to defend themselves from the inclemency of the weather, and in the protection of this they

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* Lewin, p. lvi. tab. 25. † Synonyms.——Papilio artemis. *Fabricius.*——Greasy Frittilary or Disſhclout. *Harris.*——Marsh Frittilary. *Lewin.*

pass the winter months. During this time they are so nearly reduced to a torpid state as to require no food, nor do they venture out of their general covering till invited by the warmth of the spring. As they afterwards increase in size they spread abroad in search of food; but their local attachment is very remarkable, for neither the caterpillar nor even the butterfly will stray far from the place where it was bred. Numbers of the latter may sometimes be observed on wing in a small spot of swampy or marsh land, when not one of them is to be met with in any of the adjacent places. As they fly very low, and frequently settle, the naturalist has no difficulty in catching them. The caterpillars are generally at their full growth about the last week in April: when this takes place they suspend themselves by the tail to change into chrysalids, in which state they remain about fourteen days. Their mode of suspension is a singular instance of the extraordinary power of instinct. They first draw two or three small blades of grass across towards their top, and fasten them together by means of their silk: then hang themselves beneath the centre of these, each having his own little canopy. By this means they are not only hidden from the sight of birds, but defended in a great measure from the damage they might otherwise sustain from windy and boisterous weather. They feed on the Devil's-bit Scabious (Scabiosa succisa), and on various kinds of the marsh grasses; eating only the opening leaves as they come up, which renders them sometimes difficult to find. This they do also only while the sun shines; for if in the very act the sun becomes hidden by a cloud, they immediately cease, but on the return of the sunbeams they recommence their operations with great voracity.

If any person wishes to observe the operations and change of these caterpillars at his own home, he has nothing more to do than to cut a turf from the place where they are found, and they will feed as readily there as in their former residence*.

THE NETTLE TORTOISE-SHELL BUTTERFLY †.

The upper wings of this well-known insect, one of the most beautiful and common of the British Butterflies, are red, and marked with alternate bands of black and pale orange; below these are three black spots, the inner one of which is square; and near the extremity of their upper parts is a white stripe. The lower wings are also red, marked with a large black patch at the base. The margins of all of them are black, with blue spots.

These Butterflies are produced from their chrysalids, and first make their appearance in a winged state about the month of April. They are short-lived, laying their eggs in the beginning of the following month, in great numbers, on the uppermost stalks of the nettles, and dying very shortly afterwards.

The eggs adhere by means of the glutinous moisture with which they are covered when first protruded. About the middle of the month the young caterpillars may be seen of a light green colour on the nettle-tops, enclosed in a web that covers the whole upper part of the plant; and in this they all herd together. They soon cast their first skin, when they always remove to a fresh place, leaving their old coverings hanging to the web. Here, at a little distance from their former habitation, they form a new colony. In their third skin they make another remove, but still keep together in a web. On changing this they also change their colour and become black; and as they have now increased too much in size to live in one society, they separate into companies. In their sixth or last skin they entirely separate, and in this state they often make such ravages among the nettles as to leave nothing but the stalks and fibres. Sometimes they are seen so numerous as to cover all the tops and six or seven inches of the stalks, giving them the appearance of being enveloped in black cloth.

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* Harris's Aurelian, p. lvii. tab. 28.—Lewin, p. xxxiv. tab. 15.

† SYNONYMS.—Papilio Urticæ. *Linn.*—Nettle Tortoise-shell. *Lewin.*——Tortoise-shell Fly. *Harris.*

About the beginning of June they are arrived at their full growth; when, fastening their tails by a web under the nettle-leaves or to the stalks, they change into chrysalids. These are at first green, but in a day or two they change to a bright gold, or else to a greenish brown colour. They remain thus for about twenty days, when they become Butterflies. Some few of this second brood live through the winter, being frequently found in a state nearly torpid in that season *.

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* Harris's Aurelian, p. iv. tab. 2.——Lewin, p. x. tab. 3.

These insects, in common with some others of the same family *, soon after their enlargement from the chrysalis state, discharge a few drops of reddish fluid, which, in places where they have been in great numbers, has had the appearance of a *shower of blood*, and been recorded by writers as the forerunner of some extraordinary event. The first discovery of this circumstance that has been recorded is related by M. de Reaumur. He says, that in the beginning of July, 1608, the people of the town of Aix were in the utmost alarm from what they thought a shower of blood, that had just fallen in the suburbs and for some miles round the place. M. de Peiresc, a philosopher, who, among other kinds of knowledge, had not neglected that of the operations and economy of insects, was consulted on the subject. He found the walls of a church-yard near the place, and the walls of several small villages in the neighbourhood, to be spotted with large drops of a blood-coloured liquid. A little time before this he had happened to pick up a large and beautiful chrysalis, which he had carefully laid in a box. Immediately after its transformation into the butterfly state, he remarked that it had left a drop of blood coloured liquor on the bottom of the box, and that this drop, or stain, was as large as a French sou. The red stains on the walls, on stones near the highways, and in the fields, were found to be perfectly similar to that left on the bottom of the box. M. de Peiresc now no longer hesitated to pronounce that all those blood-coloured stains, wherever they appeared, proceeded from the same cause.. The prodigious number of butterflies which he, at the same time, saw flying in the air, confirmed his original idea. He likewise observed, that the drops of the miraculous rain were never found in the middle of the town; that they appeared only in places bordering upon the country; and that they never fell upon the tops of houses, or upon walls more elevated than the height to which butterflies generally rise. What M. de Peiresc saw himself, he showed to many persons of knowledge, or of curiosity, and established, as an incontestable fact, that the pretended drops of blood were in reality but drops of a red liquid deposited there by butterflies. It is also deserving of remark, that all the showers of blood that have been recorded to have happened, took place in the warm seasons of the year, when the butterflies are most numerous.

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* Papilio Atalanta, P. Io, P. Polychloris, &c.

THE MOTHS.

The Moths are only to be seen flying abroad in the evening and during the night, which are their times of feeding. The larvæ or caterpillars are mostly smooth, and more or less cylindrical: they are very active creatures, and prey with great voracity on the leaves of various plants. Their chrysalids are either concealed in the ground, or protected from the inclemency of the weather by a silky covering which they spin round their bodies. In this state they are either simple, or have a kind of hook at their extremity.

The antennæ gradually taper from the base to the tip. The tongue is spiral, and the wings, when the animals are at rest, are generally deflected.

THE SILKWORM *.

The Silkworm is found in a native state on mulberry-trees in China and some others of the eastern countries, from whence it was originally introduced into Europe in the reign of the emperor Justinian. It is, however, at this time become, in a commercial view, one of the most valuable of all the insects; affording the delicate and beautiful threads that are afterwards woven into silk, and used in garments in almost all parts of the world.

In the warmer climates of the East, the Silkworms are left at liberty upon the trees, where they are hatched, and on which they form their coccoons; but in cooler countries where these animals have been introduced, they are kept in a room with a south aspect, built for the purpose, and fed every day with fresh leaves.

The eggs are of a straw-colour, and each about the size of a pin's head. At its birth the worm is entirely black, and about as long as a small ant; and it retains this colour eight or nine days. The worms are put on wicker shelves, covered first with paper,

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* Phalæna Mori.—*Linn.*

and on this with a bed of the most tender of the mulberry-leaves. Several ranges are placed, one above another in the same chamber, about a foot and a half apart. The scaffolding for these ranges should however be in the middle of the room, and the shelves not too deep. The worm continues feeding during eight days after its birth, when it becomes about a fourth of an inch in length: it then experiences a kind of lethargic sleep for three days, during which it casts its skin. It now feeds for about five days, and is considerably increased in size, when a second sickness comes on. In the next ten days it experiences two other attacks, by which time it has attained its full growth, and is somewhat more than an inch in length and two lines in thickness. It then feeds during five days with a most voracious appetite, after which it refuses food, becomes transparent, with a tinge of yellow, and leaves its silky traces on the leaves that it passes over. These signs denote that it is ready to begin its coccoon, in which it is to undergo its change into a chrysalis.—The animals are then furnished with little bushes of heath or broom stuck upright between the shelves: they climb up the twigs, where, after a little while, they begin the foundation of their lodge, and are five days in spinning the coccoon. They generally remain in this state about forty-seven days.

The retreat that they thus form is a cone or ball of silk, spun from two longish bags that lie above the intestines, and are filled with a gummy fluid of a marigold colour. The apparatus with which the animal is furnished for spinning the silky threads that principally compose this bag, resembles in some measure a wire-drawer's machine, in which gold or silver threads are drawn to any degree of fineness; and through this the animal draws its thread with great assiduity. As every thread proceeds from two gum-bags, it is probable that each supplies its own; which however are united as they proceed from the animal's body. If we examine the thread with a microscope, it will be found flattened on one side, and grooved along its whole length. Hence we may infer, that it is doubled just upon its leaving the body, and that the two threads stick to each other, by the gummy quality they possess.

In a state of nature the Silkworm, previous to the spinning of its web, seeks out some convenient place to erect its cell without any obstruction. When it has found a leaf, or a chink fitted to its purpose, it begins to writhe its head in every direction, and fastens its threads on every side to the walls of its retreat. These, being continued, form at length the little oval ball in which it is to undergo its change.

The exterior of the coccoon is composed of a kind of rough cotton-like substance, which is called floss; within, the thread is more distinct and even; and next the body of the aurelia the apartment seems lined with a substance of the hardness of paper, but of a much stronger consistence. The thread which composes the coccoon is not rolled regularly round, but lies upon it in a very irregular manner, and winds off first from one side, and then from the other.

In the course of six or seven days all the coccoons are generally formed: they are then taken off the branches of heath, and divided into classes. The best are strong, and of a pure unspotted colour. Some are white, and others yellow. The good ones are firm and sound, of a fine grain, and have both ends round and strong. Those of a bright yellow yield more silk than the others. But the pale ones are preferred, because they take certain colours better, and because, since they contain less gum than the others, they lose less than those in boiling.

Five or six days after the coccoon has been detached from the branches, the birth of the moth is prevented, as this would otherwise pierce the shell, and thereby render the coccoon useless. To prevent this, the coccoons are put into long shallow baskets, covered up, and baked for about an hour in an heat equal that of an oven from which the bread is just drawn after being baked.

After the baking, they are disposed in a proper manner on ozier shelves, distributed into stories two or three feet distant from each other.

The whole thread if measured will be found about three hundred yards long; and it is so very fine that eight or ten threads are generally rolled off into one by the manufacturers. For this purpose the coccoons are put into small coppers or basons of water, each over a small fire. The ends of the threads are found by brushing them over gently with a whisk made for the purpose, and in winding, they are each passed through a hole in an horizontal bar of iron placed at the edge of the bason, which prevents them from becoming entangled.

It is generally a fortnight or three weeks before the insect within the coccoon is changed into a moth; but no sooner is it completely formed, than, having divested itself of its aurelia skin, it prepares to burst through its prison. For this purpose it extends its head towards the point of the coccoon, and gnaws a passage through its cell, small at first, but enlarging as the animal increases its efforts for emancipation. The tattered remnants of its aurelia skin are left in confusion within the coccoon, like a little bundle of dirty linen.

The animal, thus set free, appears exhausted with fatigue, and seems produced for no other purpose than to transmit a future brood. The male dies immediately after its conjunction with the female; and she only survives him till she has laid her eggs, which are to be hatched into worms in the ensuing spring.

In many parts of Italy, the inhabitants contrive to have two silk harvests in the year. They keep the eggs in very cool places, and when the mulberry trees (after having been stripped entirely of their leaves for former worms) begin to bud a second time, they expose the eggs to be hatched.

During the whole time in which the animals continue in a worm state, the utmost care and attention is necessary, as they are extremely susceptible of cold, dampness, and unpleasant smells*.

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* Hare and Skinner on the Progress of the Silkworm from the Egg. Amer. Phil. Tran. ii. 347.

THE CLOTHES MOTH*.

The larva of this little moth is well known from the damage it commits on woollen cloth and furs. These substances constitute the principal support of this caterpillar, and therefore the parent is by its natural instinct directed to deposit its eggs in them. The caterpillar as soon as it quits the egg begins to form for itself a nest: for this purpose, after having spun a fine coating of silk immediately around its body, it cuts the filaments of the wool or fur, close by the thread of the cloth, or by the skin, with its teeth, which act in the manner of scissars, into convenient lengths, and applies the bits, one by one, with great dexterity, to the outside of its silken case, to which it fastens them by means of its silk. Its covering being thus formed, it never quits it, but in cases of the most urgent necessity. When it wants to feed, it puts out its head at either end of its case, as best suits its conveniency. When it wishes to change its place, it puts out its head and its six fore legs, by means of which it moves forward, taking care first to fix its hind legs into the inside of the case so as to drag it along.

It lives in this manner till, by the augmentation of its size, its case becomes too small for the body: when this is felt, it begins by making a small addition to one end; then turning itself within the case, which is always wide enough in the middle for that purpose, it makes a like addition to the other end, so as still to preserve the widest part exactly in the middle; and in the same manner it makes every successive addition.

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* Phalænâ Sarcitella. *Linn.*

The progress of its operations may be easily remarked, by transferring it from cloth of one colour to that of another. In this case every fresh addition will become conspicuous, by forming a small ring of the respective colours at each end as they are used.

When the case wants widening, the insect, with its scissar-like teeth, begins by making a slit lengthways, from the centre to one of the extremities. This opening it instantly fills up with a thin stripe of wool externally, and silk internally, in the same manner as in the other parts. It afterwards at a little distance from this makes another slit at the same end, which it also fills up; then turning itself within, it repeats the same process from the centre to the other end.

After changing within its case into a chrysalis, it, in about three weeks, issues a small-winged nocturnal moth of a silvery-grey colour, well known to almost every mistress of a family.

It may be found useful to point out the best modes of preventing the havoc these insects commit in our wardrobes and furniture.

The smell of oil of turpentine is instantaneous death to them: if therefore the goods affected by them be put into a close place, along with a saucer or other open vessel containing oil of turpentine, the warm air raising the vapour will immediately destroy them. Sometimes, if the caterpillars be old and strong, it may be necessary to brush the clothes with a brush, the points of which have been dipped in the turpentine. The smoke of tobacco also kills them: and cloth that has been steeped in a decoction of tobacco leaves will never be affected by them.

THE DRAGON-FLIES*.

THE Dragon-flies are an extremely ravenous tribe, hovering over the stagnant waters, as the hawks do over the land, in search of prey. Their larvæ are active inhabitants of the water, and, furnished with forcipated jaws, they prey with the most rapacious ferocity on aquatic insects. The aurelia resembles the larva in every respect except in having the rudiments of wings.

In both these primary states the animals respire water by receiving and ejecting it at an aperture at the termination of their bodies. They are sometimes seen, at certain intervals, to throw out water from thence with such force, that the stream is perceptible at the distance of two or three inches from their bodies. When kept some time out of water, the desire or necessity of respiration is augmented; and, accordingly, when replaced in a vessel filled with water, inspirations and respirations are repeated with unusual force and frequency. If one of them is held in the hand, and drops of water are applied to the posterior end of its body, it instantly, by an apparatus somewhat similar to the piston of a pump, sucks in the water, and the dimensions of its body are visibly augmented. This water is again quickly thrown out by the same instrument. But, though this insect thus respires water, air seems to be not the less necessary to its existence; for, like other insects, the whole interior part of its body is amply provided with large and convoluted tracheæ; and, externally, there are several stigmata destined for the introduction of air.

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* The Linnean order of NEUROPTEROUS INSECTS commences with this tribe.

The mouth of the Dragon-fly is armed with jaws, generally more than two in number. The antennæ are very thin, of equal thickness throughout, and shorter than the thorax. The wings are expanded, and the tail of the male insect is furnished with a forked process.

THE GREAT DRAGON-FLY*.

The length of this insect is about four inches, and it is of proportionate thickness. The eyes are blue and large. The thorax is variegated with green, yellow, and black; and the abdomen generally with blue and black, but the colours vary considerably.

This is, in its perfect state, one of the most brilliant of the British species, and affords a singular instance of the wonderful diversity of form and manners between the larva and complete states of the same animal.

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* SYNONYMS.—Libellula grandis. *Linn.*—Great Libellula, variegated Libellula.

The parent insect, towards the end of May, when ready to deposit her eggs, seeks the warm and sheltered sides of ponds or ditches. She drops them on the surface, hovering at the same time up and down just above. They immediately sink to the bottom, and, after a little while, are hatched into larvæ of a dirty brown colour with six legs, and bearing no resemblance whatever to the parent. These are excessively voracious, and destroy with their forcipated jaws multitudes of the weaker water insects. This formidable apparatus is so constructed as to fold over the face when at rest, and to be suddenly thrown forwards, when in action, to a considerable extent. The chrysaſis differs from the larva only in exhibiting the rudiments of future wings, which are enveloped in short cases or processes on the back of the animal. After remaining in this state about two years, the animal ascends the stem of some water-plant, and, sitting some time in the sun-shine, gives birth to the insect in its perfect or ultimate form. This generally so disengages itself from the skin of the chrysalis, that it leaves it in exactly its former appearance on the stem. "About the beginning of May," says Mr. Bartram in the Philosophical Transactions, "I observed many deformed water insects called *Hexapodes* creep out of the water and fix on shrubs and rushes. In this situation they continued but a few hours before their backs split open, and from the deformed creatures sprung out beautiful flies with bright shining wings, all of which in less than an hour afterwards attained their complete dimensions." At the first exclusion of the insect the wings are very weak and tender, and folded into a very narrow compass. During their unfolding, and till they become perfectly dry, it continues almost motionless, but they are no sooner completed than the little animal commences an inhabitant of the air, and would now be as effectually destroyed by continual submersion under water, as the larva would before have been by exposure to the air*.

In their complete state the Dragon-flies, as we have already remarked, feed on the smaller insects; and they are also remarkable for the vigour and celerity of their flight. Mr. Revett Sheppard informed the editor, that last summer (1801) he was sitting by the side of a pond to observe a large Dragon-fly as it was hawking backwards and forwards in search of prey, when suddenly a large white Butterfly, *Papilio Brassicæ*, flew past. The Dragon-fly instantly attacked and caught it in the air, then settled on a twig close at hand, to eat it at leisure. It bit off all the wings, and then in less than a minute devoured the whole body.

These insects, which are very common in this country, delight in sunshine, and are seldom to be seen abroad in cloudy weather, hiding themselves, during the continuance of that, under the leaves and branches of trees.

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[*] Phil. Tran. vol. xlvi. p. 323.——*Shaw's Nat. Mis. vol.* 12. *tab.* 459.

THE EPHEMERÆ OR DAY-FLIES.

THESE insects differ in many respects from all others. Their larvæ live in water (where earth and clay seem to be their only nourishment) for three years, the time they consume in preparing for their change, which is performed in a few moments. The larva, when ready to quit that state, arises to the surface of the water, and, getting instantaneously rid of his skin, becomes a chrysalis. This chrysalis is furnished with wings, which it makes use of to fly to the nearest tree or wall, and there settling, it in the same moment quits a second skin and becomes a perfect Ephemera. In this state all the species live but a very short time, some of them scarcely half an hour, having no other business to perform than that of continuing the race. They are called the insects of a day; but very few of them ever see the light of the sun, being produced after sunset, during the short nights of summer, and dying long before the dawn. All their enjoyments therefore seem confined entirely to their larva state.

The Ephemeræ are very frequent near waters, and in some places multiply enormously: about Lass in Carniola, a province in Germany, they are so numerous in the month of June, that, though but small insects, they are used as manure, and the peasants think less than 20 cart-loads a bad harvest.

The larvæ scoop out dwellings in the banks of rivers, which consist of small tubes made like syphons with two holes, the one serving for an entrance, and the other as an outlet; and these are so numerous that the banks of some rivers are often full of them. When the waters decrease they dig fresh holes lower down. The flies are hatched nearly all at the same instant, in such numbers as even to darken the air.

The females, by the help of the threads of their tails, and the flapping of their wings, support themselves on the surface of the water, and, in an almost upright position, drop their eggs in little clusters into the water*. A single insect will lay sometimes seven or eight hundred.

The mouth of the perfect insect has no jaws, but is furnished with four very short, thread-shaped feelers. The antennæ are short and thread-shaped; and above the eyes are two or three large stemmata. The wings are erect, (the lower ones much the shortest,) and the tail is terminated by long hairs or bristles.

THE COMMON EPHEMERA OR DAY-FLY†.

M. de Reaumur has described very accurately the metamorphosis of one species, which, except in the time of the year when it is produced, and the duration of its fly state, seems very much to resemble the present species, and is most probably nothing more than a variety.

On the nineteenth of August 1738, he waited for some time after sun-set on the bank of the Seine, to see, as he had been informed he might, millions of Ephemeræ come out of the water, and rise into the air, and was returning disappointed along with his servants, who were carrying a tub containing several lumps of earth full of their holes and nymphæ, when scarcely had it been set on one of the steps of the stairs, than those who had the charge of it exclaimed, "What a vast quantity of Ephemeræ are here!" M. de Reaumur seized one of the lights, and ran to the tub. Every part of the earth that was above the water was covered with Ephemeræ, some of which had just begun to put off their coverings, others had almost effected it, and others entirely completed it, and were about to take wing. A storm of lightning and rain, which had been some time coming on, now drove him into the house; but, to prevent the Ephemeræ from flying away entirely in his absence, he had the precaution to cover the tub with a cloth. The violence of the rain continued for about half an hour, and on its ceasing he returned to the garden. On taking off the covering he found the number of Ephemeræ very considerably augmented, and they continued to multiply for some time as he stood watching them. The number already transformed from the earth that they had conveyed from the river, would have been sufficient to have filled the tub; but this number was prodigiously augmented by the accession of strangers, which were attracted by the light from all quarters. He again spread the cloth over the tub, and the light was held above it: immediately the cloth was almost concealed by the vast multitudes which alighted upon it. But what he had seen about the tub was nothing to what he saw when he went again to the side of the river. "The quantity of Ephemeræ," says he, "which filled the air, can neither be expressed nor conceived. When snow falls thickest and in the largest flakes, the air is never so completely filled with them as that which surrounded us was with Ephemeræ. Scarcely had I remained a few minutes in one place, when the step on which I stood was covered in every part with their bodies to the depth of two or three, and in some places even of more than four inches. The whole surface of the water, for six feet at least from the bank, was entirely covered with a coat of Ephemeræ; those which the current carried off were more than replaced by those which fell continually in that place. I was several times obliged to abandon my station by retreating to the top of the stair, not being able to sustain the shower of Ephemeræ which, not falling so perpendicularly as an ordinary shower, or with an obliquity equally constant, struck me uninterruptedly, and in a very troublesome manner, on all parts of the face: my eyes, nose, and mouth were filled with Ephemeræ. It was an unpleasant post to hold the candle on this occasion; the man who held it had his whole body covered with these flies in an instant; they rushed to him from all parts in such quantities as to oppress him. The light of the candle occasioned a spectacle altogether different from any thing that can be observed in any kind of meteorological shower: it was enchanting when once observed. The most unobserving of my domestics could scarcely ever have been tired of admiring it. No astronomic sphere was ever formed so complicated as it was, nor furnished with so many circular zones in every possible direction, having the flame of the candle for their common centre. Their number appeared to be infinite, having all possible degrees of obliquity with respect to each other. Each zone was formed by an uninterrupted string of Ephemeræ, which, as if tied together, followed each other close in the same line; they seemed to form a circular ribbon of silver, deeply indented on its edges; a ribbon formed of equal triangles put end to end, so that the angles of those that followed were supported by the base of that which preceded, the whole moving round with great quickness. Ephemeræ whose wings only were then distinguishable, and which circulated around the light, formed this appearance. Each of these flies, after having described one or two orbits, fell to the earth, or into the water, but without having been burned by the candle." At the end of about half an hour from its commencement the great shower began to abate, and in little more than an hour scarcely any Ephemeræ could be seen above the river, and no more came near the candle. This phænomenon M. de Reaumur found, upon examination, took place every evening, commencing usually about the same hour, during most of the summer months.

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* Barbut's Gen. Insect. 213.

† Ephemera vulgata. *Linn.*

In this short period of existence, the female appears to have no other business than to lay her eggs. These are contained in two large packets, each containing from 300 to 400, which are both extruded from the body at the same time, through two openings formed for the purpose, and they fall together, in one accumulated mass, upon the water. To enable the creature to extrude these, and at the same time to fill up the great vacuum in the abdomen that must instantaneously take place, the fly is provided with a couple of small bladders which it has the power of filling with air.

The singular quickness and ease with which these little creatures strip themselves of the slough of the nymph, in order to become flies, is very surprising. We do not draw our arm more quickly from the sleeve of a coat, than the Ephemera draws its body, its wings, its legs, and the long filaments of its tail, from that complicated vestment which forms a kind of sheath for all these parts. No sooner is a rent effected in the corcelet, and the body seen through that rent, than the rest of the operation is finished in an instant. Sometimes, indeed, it happens that the filaments of the tail cannot be so quickly disengaged as the rest of the body : in this case the insects fly away with their slough appended; and sometimes also these slender filaments are broken off.

THE MYRMELEON TRIBE.

The antennæ of these insects are about the length of the thorax, and thickest at the tip. The mouth is armed with jaws, teeth, and six feelers. The wings are deflected; and the abdomen of the male terminates in a forceps composed of two straight filaments.

The larvæ are hairy, with six feet, and strong exserted toothed jaws. They prey with most savage ferocity on ants and some of the other smaller insects; and, for the purpose of ensnaring the prey, form a kind of funnel or pit in light earth, at the bottom of which they lie buried. The manners of most of the tribe greatly resemble those of the following species.

The chrysalis is inclosed in a ball of sand or earth, that adheres together by a viscid matter which the larva mixes with it previous to its change.

THE ANT-LION*.

The name of this insect is received from its living principally on ants. It is the caterpillar of a fly somewhat resembling the dragon-fly. In the mode of taking its prey, and in the figure of its body, it is not much unlike the spider. Its body is composed of several rings, and its colour is a dirty grey, marked with black spots. The head is small and flat, and from this proceed two horns, each about the sixth of an inch long, hard, hollow, and hooked at the end.

In its larva state this creature obtains its food only by stratagem. His usual situation is in a dry sandy soil, under some old wall or other protection from the wind. Here he forms a pit of the shape of a funnel. If this is only to be small, he thrusts himself backward pretty deep, and artfully throws out the loose sand, which has fallen in upon him, beyond the edges of the hollow, and at the bottom he then lies concealed. If it is to be of greater extent, he begins by first tracing in the surface of the sand a pretty large circle, which is to form its base. He then gets under the sand near the edge, and, proceeding backwards in a spiral direction, carefully throws up all the particles that fall upon his body beyond the circumference of the circle: this he continues till he arrives at the apex of the cone he has thus formed. His long neck, and flat head, he uses as a spade; and the strength of these parts is so great, that he is able to throw off at once a considerable quantity of sand to even six inches distance.

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* Myrmeleon formicarius. Linn.

His pit being finished, he buries himself among the sand at the bottom, leaving only his horns visible. Here he patiently waits for his prey. When an ant or any other small insect happens to walk over the edges of the hollow, its steps throw down some of the particles; which gives the Ant-lion notice of its presence. He immediately throws up the sand which covers his head to overwhelm the ant, and, with its returning force, bring it to the bottom: this he continues to do till the insect is overcome and falls between his horns. Every endeavour to escape when once the incautious ant has stepped within the verge of the pit is vain; for in all its attempts to climb the side the deceptious sand slips from under its feet, and every struggle precipitates it still lower. When within reach its enemy plunges the points of his jaws into its body, and, having sucked out all its juices, throws out the empty skin to some distance, that the den may not become frightful to others by seeing their fellow carcasses strewed about it. This done, the insect mounts the edges of his pit, and repairs whatever injury it may have suffered; and then, descending, again conceals himself at the bottom.

The jaws of this creature are hollow, and serve as pumps to draw into its stomach the juices of those insects on which it feeds; for in the head there is no mouth, nor any other organ than these which can answer the same purpose. The horns being therefore so necessary to its life, nature has provided for the restoring of them in case of accident; for, if cut off they are found to grow again.

The food this creature procures by its pit can be but little; and as it has no power of catching its prey in any other way, its motions being very slow, some persons have believed that its catching now and then an ant by this means was rather an act of diversion than hunger. But though the Ant-lion will live a long time without food, and even pass through all its changes when shut up in a box, yet it is always ready to eat when food is offered to it. It always appears starved and small when kept thus; and if a fly is given to it in this hungry state, it will suck out all its juices so perfectly that the remaining shell may be rubbed to powder between the fingers, while the body of the creature that has sucked it appears remarkably swelled and distended. For the sake of experiment, M. Poupart put one of them into a wooden box with some sand, and covered it with a glass, so as to exclude every other insect. Here it formed its cone, and watched as usual for prey, though in vain. Thus he kept it for several months, while in an adjoining box he kept another of the same species which he supplied with food by giving it ants and flies pretty regularly. He could perceive no difference between the movements or actions of the two; but when he took them from their holes, he found the abdomen of that which had received no food was shrunk to a very diminutive size, while the other retained its proper shape.

When the Ant-lion has lived its usual time in the larva state, it leaves its pit, and buries itself under the surface of the sand. Here it incloses itself in a fine web, in which it is to pass its transformation into a winged state. This web is made of a sort of silk, which the creature spins in the manner of the spider, and of a quantity of the grains of sand cemented together by a glutinous humour which flows from its pores. This case, however, would be too harsh and coarse for the body of the creature, and therefore it serves only for the covering, to defend it from external injuries; the animal spinning one of pure and incomparably fine silk, of a beautiful pearl colour, within it, which covers its whole body.

When it has lain some time in this case, it throws off its outer skin, and becomes an oblong nymph, in which a careful eye may trace the form of the fly into which it is to be transformed. This nymph makes its way about half out of the shell, and remains in this condition, but without further life or motion, till the perfect fly comes out at a slit in the back. In this last state, as we have before observed, it much resembles the dragon-flies that are common about our waters.

When this insect forms its pit in a bed of pure sand, it is made and repaired with great ease; but, where it meets with other substances among the sand, the labour becomes much more embarrassing. If, for instance, when the creature has half formed it, it comes to a stone of some moderate size, it does not desert the work on this account, but goes on, intending to remove that impediment the last. When the pit is finished it crawls backward up the side of the place where the stone is, and, getting its tail under it, takes great pains and time to get it on a true poise, and then begins to crawl backward with it up the edge to the top of the pit to get it out of the way. It is a very common thing to see the Ant-lion labouring in this manner at a stone four times as big as its own body; and as it can only move backward, and the poise is difficult to keep, especially up a slope of such crumbling matter as sand, which moulders away from under its feet, and necessarily alters the position of its body, the stone very frequently rolls down, when near the verge, quite to the bottom. In this case the animal attacks it again in the same way, and is not often discouraged by five or six miscarriages; but continues its struggles so long, that it at length gets it over the verge of the place. When it has done this, it does not leave it there, lest it should roll in again; but is always at the pains of pushing it farther on, till it has removed it to a necessary distance from the edge of the pit.

The insect in a perfect state is but seldom found: it is, however, sometimes to be met with in sandy places and near rivulets.

THE ICHNEUMON TRIBE*.

ALL the Ichneumons are parasitical, their larvæ deriving support from other insects. The female, when about to lay her eggs, perforates with her sting either the body or the nidus of some other insect or caterpillar, and deposits them there. The sting of one of the species is, though extremely fine, so strong as to penetrate through mortar and plaster. The food of the family to be produced from the eggs of this fly is the larvæ of wasps or mason-bees; for it no sooner discovers one of those nests, than it fixes on it, and in a moment bores through the mortar of which it is built.

Some species agglutinate their eggs upon caterpillars; others penetrate their bodies, and deposit the eggs in their inside. When the larvæ are hatched, the head is so situated, that they pierce the caterpillars and penetrate to their very entrails. These larvæ suck the nutritious juices of the creatures without attacking their vitals; for they seem to be all the time perfectly healthy, and even sometimes are enabled to transform themselves into chrysalids. "A friend of mine," says Dr. Derham, "put about forty large caterpillars, collected from cabbages, on some bran and a few leaves, into a box, and covered it with gauze to prevent escape. After a few days we saw, from more than three fourths of them, about eight or ten little caterpillars of the Ichneumon fly come out of their backs, and spin each a small coccoon of silk, and in a few days the large caterpillars died."—The Ichneumons performed singular service, in the years 1731 and 1732, by multiplying in the same proportion as the caterpillars: their larvæ destroyed infinitely more of them than could possibly have been done by all the efforts of human industry *.

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* The Linnean order of HYMENOPTEROUS INSECTS commences here.

Plant-lice, and the larvæ of various other insects, are also made the nidus of the Ichneumon. And there are Ichneumons in the woods sufficiently powerful to attack even the spiders. "I lately saw," says Mr. White, "a small Ichneumon fly attack a spider much larger than itself on a grass walk. When the spider made any resistance, the Ichneumon applied her tail to him and stung him with great vehemence, so that he soon became dead and motionless. The Ichneumon then running backward drew her prey very nimbly over the walk into the standing grass.—This spider would be deposited in some hole, where the Ichneumon would lay some eggs; and as soon as the eggs were hatched, the carcase would afford ready food for the maggots.—Perhaps indeed some eggs might be

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* Barbut's Gen. Insect. 245.

injected into the body of the spider in the act of stinging *."

The antennæ of the Ichneumon flies are tapering, and consist of more than thirty joints or articulations. The mouth is armed with jaws, and has four unequal thread-shaped feelers. At the extremity of the abdomen is a long sting, possessed, however, of no pungent property, inclosed in a cylindrical sheath composed of two valves.

ICHNEUMON MANIFESTATOR.

The present species is about an inch in length from the head to the extremity of the abdomen: the tail measures near an inch and a half, and the antennæ somewhat more than half an inch. The body is black, and the legs are dusky. The abdomen is cylindrical and sessile, not being connected with the thorax, as in several of the species, by a pedicle.

The care and attention paid by the whole of the animal creation to the preservation of their offspring, is a subject that has employed the attention and excited the admiration of all ages; yet there are few creatures in which these properties are more manifest than in this diminutive animal.

Thomas Marsham, esq. a most accurate observer of nature, seems to have been the first who has recorded this part of the economy of the Ichneumon Manifestator. In the month of June 1787, he observed one of these insects on the top of a post

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* White's Naturalist's Calendar.

in Kensington Gardens. It moved rapidly along, having its antennæ bent in the form of an arch, and, with a strong vibratory motion in these, felt about until it came to a hole made by some insect, into which it thrust them quite to the head. It remained about a minute in this situation apparently very busy, and then, drawing its antennæ out, came round to the opposite side of the hole, and again thrust them in, and remained nearly the same time. It next proceeded to one side of the hole, and repeated the same operation there. Having now again drawn out its antennæ, it turned about, and, dexterously measuring a proper distance, threw back its abdomen over its head and thorax, and projected the long and delicate tube at its tail into the hole. After remaining near two minutes in this position, it drew out the tube, turned round, and again applied its antennæ to the hole for nearly the same time as before; and then again inserted its tube. This operation was repeated three times; but Mr. M. approaching too near, in order if possible to observe with a glass what was passing in the tube, he frightened the insect entirely away.

About a week afterwards Mr. M. was in Kensington Gardens, and saw several of these Ichneumons at work. They appeared to pierce the solid wood with their tubes, which they forced in even to half their length, constantly passing them between the hinder thighs, which they closed in order to keep the tubes straight when over-resistance forced them to bend. It appeared truly surprising to see an instrument apparently weak and slender, able, with the strength of so small an animal, to pierce solid wood half or three quarters of an inch deep; but on particular attention it was discovered, that all those that appeared to pierce the solid wood, did it through the centre of a small white spot resembling mold or mildew, which on minute examination was found to be fine white sand, delicately closing up a hole made by the *Apis maxillosa*, and where no doubt there were young bees deposited.

In deep holes that were not closed, the insect not only thrust in the whole tube, but in some cases the whole of the abdomen and posterior legs, leaving out only the two fore-feet and wings, which it placed in contrary directions like arms. The two cases of the tube were also projected up the back, with the ends appearing above the head out of the hole.

From Mr. Marsham's account it appears that they do not adopt any hole indiscriminately as a situation for their eggs; for, in many instances, he saw them thrust their antennæ into holes and crevices from which they almost immediately withdrew them, and proceeded in search of others. As the whole of this tribe of insects deposit their eggs in the body of some other creature as a nidus, it appears probable that in these instances they found the holes empty, and that they went on in search of those in which the young of the *Apis maxillosa* were deposited.

Another particular instance of sagacity in one of these little animals is deserving of remark. While it had its tube inserted, the cases were as usual projected upwards out of the hole; and the wind being very powerful rendered it difficult for this delicate animal to maintain its situation, as these long cases were so strongly acted upon by the wind as to endanger its being overset several times. To remedy this inconvenience, it, with a wonderful dexterity, brought the cases down between its legs, and projected them forwards under its body toward the head; by which means it retained its situation securely *.

THE SPHEGES.

MANY species of the Sphex are common in England; they are chiefly found in woods and hedges. Their larvæ feed upon dead insects, in the bodies of which they are produced from the egg.

Some of the species dig holes in the earth, like dogs, with their fore feet, in each of which they bury a dead insect, after depositing their eggs in its body, and then carefully close them up again with earth.

No creatures whatever display greater affection for their offspring than these; nor are any more rapacious. They are the fiercest of flies, and without hesitation attack insects much larger than themselves. Their strength is very great, their jaws are hard and sharp, and their stings armed with a poison which suddenly proves fatal to most of the creatures

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* Linn. Tran. iii. 23.

with which they engage. The Sphex seizes with the greatest boldness on the creature it attacks, giving a stroke with amazing force, then falling off to rest from the fatigue of the exertion, and to enjoy the victory. It keeps, however, a steady eye on the object it has struck till it dies, and then drags it to its nest for the use of the young. The number of insects that this creature destroys is almost beyond conception, fifty scarcely serving for a meal: the mangled remains about the mouth of its retreat sufficiently betray the sanguinary inhabitant. The eyes, the filament that serves as a brain, and a small part of the contents of the body, are all that the Sphex eats.

The antennæ in this tribe consist of ten joints or articulations; and the mouth is armed with jaws. The wings in both sexes are extended, and not folded. The sting is pungent, and concealed within the abdomen.

THE BLUE SPHEX*.

These little creatures form for their cells cylindrical pipes of clay, each about the thickness and length of the little finger, against the timber under the roofs of houses, or under pales where they may be sheltered from the weather. They form eight or ten of them alongside and joining upon each other. Each of these tubes is divided by several partitions, betwixt every one of which the female lays an egg;

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* Synonyms.—Sphex cyanea. *Linn.*—Vespa Ichneumon cærulea. *Catesby.*

and as they are formed, they are stopped up; but none of them without an egg, and the bodies of several insects to support the future young before it can come to light. When one is stopped up another is begun at its end, and so on till the whole work is completed. These insects are silent at all times except during the plastering and forming of their cells; and they no sooner set about their work than they always emit an odd but pleasing sound, which is audible at the distance of ten or twelve yards, and seems to render their labour cheerful. It is exceedingly diverting to observe the surprising dexterity and the whimsical gesticulations that they adopt in performing this important business. They first moisten the clay, then temper it into a little lump of the size and shape of a swan-shot, and apply it to the walls of their nest. They commence their operations at the upper part, and work downwards till the cell is long enough to contain the chrysalis. After having spread out this little lump in a proper manner, they return for fresh materials. They cease their humming noise the moment they depart from their cell, but always commence it immediately on putting together the materials they have been out for. When a cell is finished they are always very careful to render it perfectly smooth on the inside.

The insects that this fly secures for its young are principally spiders, which will in some measure account for its generally forming its cell under roofs of buildings and other places where spiders are usually found. It does not kill them, but only in some manner so disables them that they cannot escape; by which means they are preserved alive and uncorrupted till the young larva is produced, which is not long after the egg is deposited. They sometimes seize and fly off with spiders that are equal in size with themselves; and when one of them proves too weighty to be carried off, if it is not at a great distance the insect drags it to her nest. Mr. Catesby once saw an exceedingly large spider dragged up a wall by one of these flies to its nest; and both of them being caught and weighed, it was found that the spider was eight times the weight of the fly.

By the time the larva has devoured all its provision, it is ready to undergo its change, and for this purpose spins itself up in a fine soft silken case about the end of September, and remains in a chrysalis state till the spring; when it gnaws its way out of the claycy dwelling, and becomes an inhabitant of the air.

The insect is then about three quarters of an inch long, and of a dark blue colour. The pedicle connecting the abdomen and thorax is about a quarter of an inch in length. The antennæ are black, and the wings blueish and tipped with black.—It is found in Carolina and various other parts of North America [*].

THE PENNSYLVANIA SPHEX [†].

The nest of this species, as well as that of the last, is formed with considerable art and ingenuity. The insect scratches in the steep side of some bank of loamy earth an horizontal hole, about an inch in diameter and near a foot long, making it smooth within, and preſſing the earth so strongly as to secure it from giving way. She then flies off and seizes one of the large green grashoppers, and lodges it safely at the farther end; and after laying an egg she again goes off and catches two others, which she deposits with the former, and then closes up the hole. The larva when produced feeds on the bodies of the grashoppers till its change into a chrysalis. It remains in this state for some time; but when it becomes perfected, it eats its way out, and flies off.

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[*] Phil. Tran. n. 476. p. 363.—Vol. xliii. p. 363.—Catesby App. p. 5.

[†] Synonyms.—Sphex Pennsylvanica. *Linn.?*—Great Black Wasp from Pennsylvania. *Bartram.*

The grashoppers caught for the young are often much larger and more strong than the parent insect, so that considerable care is necessary in attacking them. She is said to seize them suddenly, and to plunge her sting into their body in such a manner as not to kill but merely to render them inactive: for, as in the last species, it is necessary that they should be kept alive for some time in the nest, or they would otherwise putrefy, and become unfit for the purpose they were designed to answer *.

This species is above an inch long, and of a black colour, with the wings inclining to violet. It is an inhabitant of North America, where it feeds on grashoppers and other insects, as well as on various kinds of fruit.

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* Phil. Tran. vol. xlvi. p. 126.

THE TURNER SAVAGE[*].

This insect lives by choice among men, whom it never offends, but it is the terror of all the smaller insects. It inhabits holes in the earth on the sides of hills and cliffs, and recesses that it forms in the mud-walls of cottages and outhouses. In Peterborough, in Northamptonshire, one was taken, which had formed its cell in the mud-wall of a cottage, that was wrought into the appearance of honey-comb by the multitude of these creatures.

The eggs, as in other species, are laid in the back part of the cells, which are supplied with insects and then filled up[†].

Dr. Derham says, that a species of savage, or ichneumon wasp, built its nest in a little hole in his study window. The cell was coated over with an odoriferous and resinous gum, collected as he supposed from some neighbouring fir-trees: the insect laid two eggs, and he soon after observed it several times carry in maggots, some of which were bigger than itself. These it very sagaciously sealed up with great carefulness in the nest, where it left them.

THE SAND-WASP.

THIS tribe is separated from the last by the R Mr. Kirby. In their manners and economy, insects of each bear a near resemblance.

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[*] Sphex Spirifex. *Linn.* [†] Barbut's Gen. Insect. p.

The rostrum or beak is conical, inflected, and contains a retractile tubular tongue, that is cleft at the end. The jaws are forcipated, and three-toothed at the tip; and the antennæ in each sex are filiform, with about fourteen joints or articulations. The eyes are oval, and the wings plane. The sting is pungent, and concealed in the abdomen.

THE COMMON SAND-WASP*.

In this species the antennæ have thirteen articulations, and are inserted in a hollow on the front of the head. The abdomen is club-shaped, and joined to the thorax by a long two-jointed pedicle. The wings are equal, and the colours of the body black and ferruginous alternately.

It is very common about sandy banks exposed to the sun, in Norfolk and Suffolk, but rare in the neighbourhood of London. It is easily distinguished from other insects by the elongated pedicle of its abdomen, and very short wings. When it flies, it always carries its abdomen pointing upwards, so as to be nearly at right angles with that part of the thorax to which it is attached†.

Its history is interesting, but in its manners it is greatly allied to the species of the preceding genus. The most pleasing fact is that related by Mr. Ray: "I observed one of them (says he) dragging a green caterpillar thrice its own size; it laid this down near the mouth of a burrow that it had made in the ground; then removing a little ball of earth with which it had covered the orifice, it first went down itself, and after staying a short time returned, and, seizing the caterpillar again, drew it down with him. Then leaving it there, it came up, and, taking some little globules of earth, rolled them one by one into the burrow, scraping the dust in by intervals with its fore feet, in the manner of a dog; thus alternately rolling in pieces of earth, and scraping in dust, till the hole was full; sometimes going down (as it seemed to me) to press down the earth; and once or twice flying to a fir-tree which grew near, perhaps to get turpentine to glue it down, and make it firm. The hole being filled and equalled with the superficies of the earth, that its entrance might not be discovered, it took two fir-leaves that were near, and laid them by the mouth; most probably to mark the place*."

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* SYNONYMS.—Sphex sabulosa. *Linn.*—Ammophila vulgaris. *Kirby in Linn. Tran.*

† Kirby in Linn. Tran. iv. 185.

THE WASP TRIBE.

The Wasps are in general found in large societies, like the bees, constructing curious combs or nests, in which they deposit their eggs. Some however are solitary, and form for each young a separate nest. Their larvæ are soft, without feet, and are fed with the nectar of flowers and honey, but of a kind very inferior to that collected by the bees. The chrysalis is without motion, and has the rudiments of wings.

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* Ray Hist. Insect. p. 254.

A distinguishing popular character of this genus is their having smooth bodies, apparently without hairs, and each of their upper wings folded, when at rest, through their whole length. At the base of each of these is a scaly process, that performs the office of a spring, in preventing them from rising too high; a caution of some importance to these carnivorous insects, which pursue their prey on full stretch of wing.

The mouth is horny, and furnished with a compressive jaw, and four unequal thread-shaped feelers. The antennæ are also filiform, the first joint longer than the rest, and cylindrical. The sting is pungent, and concealed within the abdomen.

THE COMMON WASP*.

The Common Wasp always forms its nest under the surface of the earth, in a dry soil, and not unfrequently occupies with it a forsaken dwelling of the mole. The hole that leads to it is about an inch in diameter, from half a foot to two feet deep, and generally in a zigzag direction.

When it is exposed to the view, the whole nest appears to be of a roundish form, and sometimes about twelve or fourteen inches in diameter. It is strongly fortified all round with walls, in layers, formed of a substance somewhat like paper, the surface of which is rough and irregular. In these walls, or rather in this external covering, two holes are left for passages to the combs, one of which is uniformly adopted for entrance, and the other as a passage out. The interior of the nest consists of several stories or floors of combs, which are parallel to each other, and nearly in an horizontal position. Every story is composed of a numerous assemblage of hexagonal cells, very regularly constructed, of a matter resembling a kind of ash-coloured paper. These cells contain neither wax nor honey, but are solely destined for containing the eggs, the worms which are hatched from them, the chrysalids, and the young wasps till they are able to fly. The combs are from eleven to fifteen in number. Reaumur computed the number of cells in the combs of a middle-sized nest to be at least ten thousand; and as every cell serves for no less than three generations, a nest of this description would annually give birth to *thirty thousand* young wasps.

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* Vespa vulgaris. *Linn.*

The different stories of combs are always about half an inch high, which leaves free passages to the wasps from one part of the nest to another. Each of the larger combs is supported by about fifty pillars, which, at the same time that they give solidity to the fabric, greatly ornament the whole nest. The lesser combs are supported by the same contrivance. The wasps begin at the top and work downward, the uppermost comb being first constructed, and attached to the superior part of the external covering. The second comb is affixed to the bottom of the first, and in this manner the animals proceed till the whole is completed.

M. de Reaumur, in order to examine some parts of the internal economy of these insects, contrived to make them lodge and work in glass hives like the Honey-bees. Their extreme affection for their offspring aided him greatly in this; for he found that although their nest was cut in various directions, and even exposed to the light, they never deserted it, nor relaxed in their attentions to the young.

Immediately after a wasp's nest had been transported from its natural situation, and covered with a glass hive, the first operation of the insects was to repair the injuries it had suffered. With wonderful activity they carried off all the earth and foreign bodies that had accidentally been conveyed into the hive. Some of them occupied themselves in fixing the nest to the top and sides of the hive by pillars of paper, similar to those that support the different stories or strata of combs; others repaired the breaches it had sustained; and others fortified it by augmenting considerably the thickness of its external cover.

In the formation of their nests, Wasps differ greatly from the Bees: instead of collecting the farina of flowers and digesting it into wax, they gnaw small fibres of wood from the sashes of windows, the posts and doors of gardens, &c. which their strong and serrated jaws enable them to do with great ease. These fibres, though very slender, are often a tenth of an inch in length. After cutting a certain number, they collect them into small bundles, transport them to their nest; and, by means of a glutinous substance furnished from their own bodies, the labouring wasps, who are employed in the nest, form them into a moist and ductile paste. Of this substance they construct the external cover, the partitions of the nest, the hexagonal cells, and the solid columns that support the several stories of the comb.

In the republic of Wasps, like that of the Bees, there are three different kinds of flies, males, females, and neuters. The greatest share of labour devolves upon the neuters: but they are not, like the neuter bees, the only workers; for there is no part of the different operations which the females at certain times do not execute. Nor do the males remain entirely idle. The neuters however build the nest, feed the males, the females, and even the young. But while these are occupied in different employments at home, the others are abroad in hunting parties. Some of them attack with intrepidity live insects, which they sometimes carry entire to the nest; but if theſe are at all large, they transport only the abdomen. Others make war on the bees, killing them for the honey they have in their bodies, or plundering their hives of the fruits of their labour. Some resort to the gardens, and suck the juices of fruit: and others pillage butchers' stalls, from which they often arrive with a piece of meat, larger even than the half of their bodies. Butchers, however, frequently turn these operations of the Wasps to advantage, by hanging up before their shops a calf's liver, or any tender meat. The Wasps come in quest of this delicate food, and pursue the blue-bottle flies, from whose eggs are produced the maggots that spoil meat. When they return to the nest they distribute a part of their plunder to the females, to the males, and to such neuters as have been usefully occupied at home. As ſoon as a neuter enters the nest, it is surrounded by several Wasps, to each of which it freely gives a portion of the food it has brought. Those that have not been hunting for prey, but have been sucking the juices of fruits, though they seem to return empty, fail not to regale their companions; for, after their arrival, they station themselves on the upper part of the nest, and discharge from their mouths two or three drops of clear liquid, which are immediately swallowed by the domestics.

The neuter Wasps are the smallest, the females much larger and heavier, and the males are of an intermediate size between the two. In the hive of the Honey-bee the number of females is extremely small; but in a Wasp's nest this is often more than three hundred.

The eggs are white, transparent, and of an oblong figure; but they differ in size, according to the kind of Wasps that are to proceed from them. Eight days after they are deposited in the cells, the worms are hatched, and are considerably larger than the eggs from which they are produced. The worms demand the principal care of those Wasps that continue always in the nest. They feed them, as birds feed their young, by giving them from time to time a mouthful of food. It is astonishing to see with what industry and rapidity a female runs along the cells of a comb, and distributes to each worm a portion of nutriment.

In proportion to the ages and conditions of the worms, they are fed with solid food, such as the bellies of insects, or with a liquid substance disgorged by their foster parent. When a worm is so large as to occupy its whole cell, it is ready to be metamorphosed into a chrysalis. It then refuses all nourishment, and ceases to have any connexion with the Wasps in the nest. It shuts up the mouth of its cell with a fine silken cover, in the same manner as the silk-worm and other caterpillars spin their coccoons. This operation is completed in three or four hours, and the animal remains a chrysalis nine or ten days; when, with its teeth, it destroys the external cover of the cell, and comes forth a winged insect, which is either male, female, or neuter, according to the nature of the egg from which it was hatched. In a short time the Wasps, newly transformed, receive the food brought into the nest by the foragers from the fields. What is still more wonderful is, that in the course of even the first day after their transformation the young Wasps have been observed going to the fields, bringing in provisions, and distributing them to the worms in the cells.—A cell is no sooner abandoned by a young Wasp, than it is cleaned, trimmed, and repaired by the old ones, and rendered, in every respect, proper for the reception of another egg.

Cells are constructed of different dimensions for the neuters, males, and females; and it is very remarkable, that those of the neuters are never intermixed with the cells destined for the others.

This wonderful edifice, that requires the labour of the animals for several months, serves them only for a year; and notwithstanding its population during the summer, it is almost deserted in winter, and is abandoned entirely in the spring; for, in this last season, not a single Wasp is to be found in a nest of the preceding year. It is worthy of remark, that the first combs of a nest are always accommodated for the reception of the neuter or working Wasps, whose care and attention are first required; so that it uniformly happens, that, before the males and females are capable of taking flight, every Wasp's nest is peopled with several thousands of neuters or workers. But the neuters, which are first produced, are likewise the first that perish; for not one of them survives the termination even of a mild winter.

The female Wasps are stronger, and support the rigours of winter better, than either the males or neuters. Before the end of winter, however, several hundred females die, and not above ten or a dozen in each nest survive that season. These few females are destined for the continuation of the species. Each of them becomes the founder of a new republic. With regard to the male Wasps, it is uncertain whether any of them survive. But, though not so indolent as the males of the honey-bee, they can be of but little assistance to the female; for they never engage in any work of importance, such as constructing cells, or fortifying the external cover of the nest. They are never brought forth till towards the end of August; and their sole occupation seems to be that of keeping the nest clean: they carry out every kind of filth, and the bodies of such of their companions as happen to die. In performing this operation, two of them often join ; and when the load is too heavy they cut off the head, and transport the dead animal at twice.

Every nest about the beginning of October presents a singular and cruel scene. At this season, the Wasps not only cease to bring nourishment to their young, but drag the grubs from their cells and carry them out of the nest, where, exposed to the weather, and deprived of food, they all unavoidably perish, if the Wasps neglect, which they seldom do, to kill them with their fangs. This mode of procedure would at first seem a strange violation of parental affection ; but the intentions of nature, though they often elude our researches, are never wrong. What appears to us cruel and unnatural in this instinctive devastation, committed annually by the Wasps, is perhaps an act of the greatest mercy and compassion that could possibly have taken place. Wasps are not, like the Honey-bees, endowed with the instinct of laying up a store of provisions for winter subsistence. If not prematurely destroyed by their parents, the young must necessarily die a cruel and lingering death, occasioned by hunger. Hence this seemingly harsh conduct in the economy of Wasps, instead of affording an exception to the universal benevolence and wisdom of nature, is, in reality, a most merciful effort of instinct*.

Like the male Honey-bees, the male Wasps are destitute of stings ; but the females and neuters have stings, the poisonous liquor of which, when introduced into any part of the human body, excites inflammation, and creates a considerable degree of pain. This sting consists of a hollow and very sharp-pointed tube, having at its root a bag of pungent juice, which in the act of stinging is pressed out, and conveyed through the tube into our flesh.—There are also two small, sharp, and bearded spears lying, as in a sheath, within the tube. Dr. Derham counted eight beards on the side of each spear, which, he says, were formed somewhat like the beards of fish-hooks. These spears lie one with its point a little before the other in the sheath, to be ready, in all probability, to be first darted into the flesh; where being once fixed by means of its foremost beard, the other then strikes in also; and they in this manner alternately pierce deeper and deeper, their beards taking more and more hold in the flesh; after which the sting or sheath follows, in order to convey the poison into the wound. The hole in the tube is not exactly at the end, for in that case the instrument would not be so well able to wound: the sting is drawn to a hard and sharp point, and the incision through which the spears and poison are ejected is a little below it. By means of this mechanism it is that the sting, even when parted from the body, is able to pierce and make us smart: and by means of the beards being lodged deep in the flesh, it is also that these insects leave their stings behind them, when they are disturbed, before they have had time to withdraw their spears completely into the tube.

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* Reaum. Mem. pour servir à l'Histoire des Insectes, tom. vi.

THE BEE TRIBE.

The Bees, according to the generic character given of them by Linnæus, have a horny mouth, with the jaws and the lip membranaceous at the end. The tongue is inflected, and they have four unequal filiform feelers. Their antennæ are short and filiform, but those of the female somewhat club-shaped. The wings are flat: and the females and neuters have pungent stings concealed in the abdomen.

The English Bees have undergone an accurate examination by the Rev. Mr. Kirby, who has discovered no fewer than 221 distinct species, though fifteen years ago none of our books mentioned so many as a dozen. He divides the Linnean genus into *Melitta* and *Apis*, distinguishing them by their tongues: the insects of the former having short, flattish, uninflected tongues; and those of the other long, cylindrical, and inflected tongues, easily examined by raising them by a pin from the sheath in which they are concealed.

These insects are very numerous, and differ considerably in their habits. Some are found in extensive communities, constructing, with the utmost art, cells for their young and repositories for their food; while others both dwell and work in solitude. The whole tribe live on the nectar of flowers and on ripe fruit.

Their larvæ are soft and without feet, and the pupa resembles the perfect insect.

THE POPPY BEE [*].

The Poppy Bee forms her nest in the ground, burrowing to the depth of about three inches. At the bottom she makes a large and somewhat hemispherical cavity, which, after being rendered perfectly smooth on all sides, she carefully lines with a splendid tapestry, selected from the scarlet flowers of the wild poppy. From these, with great dexterity, she cuts pieces of proper size and form, which she conveys to her cell, and, beginning at the bottom, covers with it the whole interior of this habitation of her future progeny. The covering is even sometimes extended a little way round the orifice. The bottom is rendered warm by three or four coats, and the sides have never less than two. When the little animal has completed her apartment, she fills it with paste, made of pollen and honey, to the height of seven or eight lines; and after depositing an egg, she pushes down the poppy-lining till it completely covers the cell, and then closes up its mouth with earth so nicely as to render it not distinguishable from the adjoining soil [†].

THE LEAF-CUTTING BEE [‡].

These Bees construct cylindrical nests, of the leaves of the rose and other trees, which are sometimes of the length of six inches, and generally consist of six or seven cells, each shaped like a thimble. They are formed with the convex end of one fitting into the open end of another. The portions of leaf of which they are made are not glued together, nor are they any otherwise fastened than in the nicety of their adjustment to each other; and yet they do not admit the liquid honey to drain through them. The interior surface of each cell consists of three pieces of leaf, of equal size, narrow at one end, but gradually widening to the other, where the width equals half the length. One side of each of these pieces is the serrated margin of the leaf from which it was cut. In forming the cell, the pieces of leaf are made to lap one over the other (the serrated side always outermost) till a tube is thus formed coated with three, four, or more layers. In coating these tubes, the provident little animal is careful to lay the middle of each piece of leaf over the margins of others, so as by this means both to cover and strengthen the junctions. At the closed or narrow end of the cell, the leaves are bent down so as to form a convex termination. When a cell is formed, the next care of the Bee is to fill it with honey and pollen, which, being collected chiefly from the thistles, form a rose-coloured paste. With these it is filled to within about half a line of the orifice; and she then deposits in it an egg, and closes it with three perfectly circular pieces of leaf, which coincide so exactly with the walls of the cylindrical cell, as to be retained in their situation without any gluten. After this covering is fitted in, there still remains a hollow which receives the convex end of the succeeding cell. In this manner the patient and indefatigable animal proceeds till her whole cylinder of six or seven cells is completed. This is said to be generally formed under the surface of the ground * in a fistular passage which it entirely fills except at the entrance. If by any accident the labour of these insects is interrupted, or the edifice is deranged, they exhibit astonishing perseverance in setting it again to rights.

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[*] SYNONYMS.—Apis Papaveris. *Kirby*, i. 142. 214.—Abeille tapissiere. *Reaumur.*

[†] Kirby, i. 143.—Reaum. Mem. tom. vi. p. 93—96.

[‡] Apis centuncularis. *Linn.*

Their mode of cutting pieces out of the leaves, for their work, deserves particular notice. When one of these Bees selects a rose-bush with this view, she flies round, or hovers over it for some seconds, as if examining for the leaves best suited to her purpose. When she has chosen one, she alights upon it, sometimes on the upper, and sometimes on the under surface, or not unfrequently on its edge, so that the margin passes between her legs. Her first attack, which is generally made the moment she alights, is usually near the footstalk, with her head turned towards the point. As soon as she begins to cut, she is entirely intent on her labour, nor does she cease till her work is completed; this is done with her strong jaws, with as much expedition as we could exert with a pair of scissars. As she proceeds, she keeps the margin of the detached part between her legs, in such a manner that the section keeps giving way to her, and does not interrupt her progress. She makes her incision in a curve line approaching the midrib of the leaf at first; but when

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* In cavities of walls and in decayed wood. Kirby.

she has reached a certain point, she recedes from this towards the margin, still cutting in a curve. When she has nearly detached the portion she has been employed upon from the leaf, she balances her little wings for flight, lest its weight should carry her to the ground; and the very moment it parts she flies off with it in triumph, in a bent position between her legs, and perpendicular to her body.

The larvæ of the Leaf-cutting Bees do not differ in appearance from those of the Hive-bees. When arrived at their full size, they spin a coccoon of silk, thick and solid, which they attach to the sides of their cell. Those produced first are from the first-laid eggs, so that, when ready to emerge into the air, in passing through the bottom of their cells they do not interrupt each other's progress. These larvæ are exposed to the attacks of other insects, that make their way into the cells and deposit there their eggs.

This mode of forming a nest is not confined to the present species, as several others have similar operations, adopting the leaves of other trees than the rose for this purpose, as the horse-chesnut, the elm, &c. &c.*

APIS MANICATA †.

This singular little animal is very common about gardens in or near towns. It is from half an inch to three quarters in length; of a dark colour and hairy.

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* Kirby, i. 162.—Reaumur, vi. 97. 124. † *Linn.*

On each side of the abdomen are several yellow spots.

It forms its nest in hollow places in trees, &c. applying to this work the down of the Garden Campion*, and some other woolly plants. The Rev. Mr. White of Selborne seems to have been the first naturalist who discovered this. He says that "it is very pleasant to see with what addreſs this insect strips off the down, running from the top to the bottom of a branch, and shaving it bare with all the dexterity of a hoop-shaver. When it has got a vast bundle, almost as large as itself, it flies away, holding it secure between its chin and fore legs †."

Sir Thomas Cullum in a letter to Mr. Marsham says, "I observed in a lock to one of my garden-gates, that the key did not turn easily round, and upon looking into the key-hole I saw something white. I had the lock taken off, and it was completely full of a downy substance, containing the pupa of some bee. On examining this, I am certain it is the fine pappus or down from the *Anemone sylvestris*, of which I have two plants in my garden. I have preserved the whole as I found it, but the bee has not yet made its appearance in a perfect state." This nidus was afterwards sent to the Rev. Mr. Kirby, and five of the pupæ produced perfect insects, namely, three males and two females. On comparing the down of which it was composed with that of the Campion, Mr. K. was of opinion that

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* Agrostemma coronaria of Linnæus.

† White's Naturalist's Calendar, 109.

Sir Thomas Cullum had mistaken its composition,—as the down of the Anemone is of a more silky texture than that used in this nest. This gentleman informs us that there were several cells or cases in the lock, unconnected with each other except by the wool which was their common covering. These cells were of an oval form, and had an exterior coat of wool, under which was a membranaceous cell covered with a number of small vermiform masses of a brown substance, apparently formed of pollen and honey. These were laid, without any regular order,—over the cell; and by means of them the wool which formed its exterior coat was made to adhere. At the summit of this membranaceous case was a small orifice, and within it another cell, somewhat strong and coriaceous, of a brown colour, and shining in the inside as much as if covered with tin-foil. This was supposed to be the coccoon of the larva previous to its assuming the pupa state.

THE MASON BEE*.

The Mason Bee, which is also one of the solitary species, derives its name from the circumſtance of its constructing a nest of mud or mortar. This, on its exterior, has so little of a regular appearance, that it is generally regarded as a piece of dirt accidentally adhering to a wall. Within, however, it is furnished with regular cells, each of which affords convenient lodgement to a white larva much resembling that of the Hive-bee. In constructing this nest, which is a work of great labour and art, the female is the sole operator, receiving no assistance whatever from the male.

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* Abeille Maçonne. *Reaumur*.—It is not known to which of the Linnæan species this bee is to be referred.

After fixing upon an angle, sheltered by any projection, on the south side of a stone wall, or upon some rough part of its surface, she goes in quest of the necessary materials. Her nest is to be constructed of a kind of mortar, of which sand is to be the basis. She is very curious in her choice of this, selecting it with her jaws grain by grain. To shorten her labour, before she transports it for use, she glues together, by means of a viscid saliva from her body, as many grains as she can carry: these form a little mass, about the size of a small shot. Taking this up in her jaws, she conveys it to the place she has fixed upon for the site of her house. She labours incessantly till her whole work is completed, which usually occupies five or six days. The number of cells in one nest are from three to fifteen: these are all similar and nearly equal in dimensions, each being about an inch high, half an inch in diameter, and, before its orifice is closed, resembling a thimble in shape. When a cell is raised to somewhat more than half its height, our little mason lays up in it a store of pollen seasoned with honey for the sustenance of its future inhabitant. This being done, she deposits her egg, finishes and covers her cell, and then proceeds to the erection of a second, which she furnishes and finishes in the same manner; and so on till the whole work is completed. These cells are not placed in any regular order; some are parallel with the wall, others perpendicular to it, and others are inclined to it at different angles: this occasions many empty spaces between the cells, which the laborious architect fills up with the same kind of cement, and then bestows on the whole group a common covering, made with coarser grains of sand; so that at length the nest becomes a mass of mortar, so hard as not easily to be penetrated even by the blade of a knife.

These nests, which sometimes last for several seasons, are often the cause of desperate conflicts. When one insect has taken possession of a nest, and is gone abroad in quest of materials to repair it, another will frequently come to seize it. When these two meet, a battle always ensues. This is always fought in the air. Sometimes the two bees fly with such rapidity and force against each other, that both fall to the ground. But, in general, like birds of prey, the one endeavours to rise above the other, and to give a downward blow. To avoid the stroke, the undermost, instead of flying forward, or laterally, is frequently observed to fly backward. This retrograde flight is likewise performed occasionally by the common house-fly, and some other insects, though we are unable to perceive what stimulates them to employ so uncommon a movement.

From the hardness of the materials with which the Mason-Bee constructs her nest, and from the industry and dexterity she employs to protect her progeny from enemies of every kind, one should naturally imagine that the young would be in perfect safety, and that their castle would be impregnable.

But notwithstanding all these precautions, they are often devoured by the larvæ of a peculiar species of ichneumon fly, the eggs of which are deposited in the cells before the bee has completed them. But they have an enemy even still more formidable than the ichneumons. A species of Beetle* insinuates its egg into an unfinished cell: from this proceeds a strong and rapacious grub, armed with prodigious fangs, which often pierces through every cell in the nest, and successively devours all the inhabitants†.

THE WOOD-PIERCER‡.

The operations of the Wood-Piercers merit attention. These bees are larger than the queens of the Honey-bee. Their bodies are smooth, except the sides, which are covered with hair. In the spring they frequent gardens, and search for rotten, or at least for dead wood, in order to make an habitation for their young. They usually choose the decaying uprights of arbours, espaliers, or the props of vines; but will sometimes attack garden seats, thick doors, and window shutters.

When the female of this species, for she receives no assistance from the male, has selected a piece of wood suited to her purpose, which is most commonly such as is perpendicular to the horizon, she begins her work by boring perpendicularly into it: when she has advanced about half an inch she changes her direction, and then proceeds nearly parallel with its sides for twelve or fifteen inches, making the hollow about half an inch in diameter. If the wood is sufficiently thick, she sometimes forms three or four of these long holes in its interior; a labour which for a single insect seems prodigious, but in executing it some weeks are often employed. On the ground, for about a foot from the place in which one of these bees is working, little heaps of timber dust are to be seen. These heaps daily increase in size, and the particles that compose them are as large as those produced by a hand-saw. The strong jaws of this insect are the only instruments she employs in these perforations. After the holes are prepared, they are divided into ten or twelve separate apartments, each about an inch deep, the roof of one serving for the bottom of another. The divisions are composed of particles of wood, cemented together by a glutinous substance from the animal's body. In making one of these, she commences with glueing an annular plate of wood-dust, about the thickness of half a crown, round the internal circumference of the cavity: to this plate she attaches a second, to the second a third, and so on till the whole floor is completed. Before each cell is closed, it is filled with a paste composed of the farina of flowers mixed with honey, and an egg is deposited in it. When the larva is hatched it has scarcely room sufficient to turn itself in the cell; but as the paste is devoured, the space is enlarged so as to allow it to perform every necessary operation towards changing its state.

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* Attebalus apiarius of Linnæus.

† Kirby, i. 179.—Reaumur, vol. vi. p. 57. 88.

‡ Ap.s violacea. *Linn.*

We are informed by M. de Reaumur, that M. Pitot furnished him with a piece of wood, about an inch and a half in diameter, that contained the cells of one of these bees. He cut off as much of the wood as was sufficient to expose two of the cells to view; in each of which was a larva. To prevent the injuries of the air, he closed the aperture that he had made by pasting on it a bit of glass. The cells were at that time almost entirely filled with paste. The two worms were exceedingly small, and, of course, occupied but little space between the walls of the cells and the mass of paste. As the animals increased in size, the paste daily diminished. He began to observe them on the 12th of June; and on the 27th of the same month the paste in each cell was nearly consumed, and the worm, folded in two, occupied the greater part of its habitation. On the 2d of July the provisions of both worms were entirely exhausted. The five or six following days they fasted, which seemed to be a necessary abstinence, during which they were greatly agitated. They often bent their bodies, and elevated and depressed their heads. These movements were preparatory to the great change that the animals were about to undergo. Between the 7th and 8th of the same month they threw off their skins, and were metamorphosed into nymphs; and on the 30th of July they became perfect insects.

In a range of cells, the worms are necessarily of different ages, and of course of different sizes. Those in the lower ones are older than those in the superior; because, after the bee has filled with paste and inclosed the first cell, a considerable time is requisite to collect provisions, and to form partitions for every successive and superior cell. The former, therefore, must be transformed into nymphs and flies before the latter. These circumstances would almost appear to be foreseen by the common mother; for, if the undermost worm, which is the oldest, and soonest transformed, were to force its way upward, which it could easily do, it would not only disturb but infallibly destroy all those lodged in the superior cells. But Nature has wisely prevented this devastation; for the head of the nymph, and consequently of the fly, is always placed in a downward direction. Its first instinctive movements must therefore be in the same direction. That the young flies may escape from their respective cells, the mother digs a hole at the bottom of the long tube, which makes a communication between the undermost cell and the open air. Sometimes a similar passage is made near the middle of the tube. By this contrivance, as all the flies instinctively endeavour to cut their way downwards, they find an easy and convenient passage; for they have only to pierce the floor of their cells to make their escape, which they readily perform with their teeth *.

THE HIVE BEE †.

In the formation of their combs, the present insects seem to resolve a problem which would not be a little puzzling to some geometricians, namely,

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* Reaumur, tom. vi. † Apis mellifica. *Linn.*

" quantity of wax being given, to make of it equal " and similar cells of a determined capacity, but of " the largest size in proportion to the quantity of " matter employed, and disposed in such a manner " as to occupy in the hive the least possible space." Every part of this problem is completely executed by the bees. By applying hexagonal cells to each others' sides, no void spaces are left between them; and, though the same end might be accomplished by other figures, yet such would necessarily require a greater quantity of wax. Besides, hexagonal cells are better fitted to receive the cylindrical bodies of these insects.—A comb consists of two strata of cells applied to each other's ends. This arrangement both saves room in the hive, and gives a double entry into the cells of which the comb is composed. As a further saving of wax, and for preventing void spaces, the bases of the cells in one stratum of a comb serve also for bases to the opposite stratum. In short, the more minutely the construction is examined, the more will the admiration of the observer be excited. The walls of the cells are so extremely thin, that their mouths might be thought in danger of suffering by the frequent entering and issuing of the bees. To prevent this disaster, however, they make a kind of ring round the margin of each cell, and this ring is three or four times thicker than the walls.

It is difficult to perceive, even with the assistance of glass hives, the manner in which bees operate when constructing their cells. They are so eager to afford mutual assistance; and for this purpose so many of them crowd together, and are perpetually succeeding each other, that their individual operations can seldom be distinctly observed. It has, however, been plainly discovered, that their two jaws are the only instruments they employ in modelling and polishing the wax. With a little patience and attention, we perceive cells just begun: we likewise remark the quickness with which a bee moves its teeth against a small portion of the cell. This portion the animal, by repeated strokes on each side, smooths, renders compact, and reduces to a proper thinness. While some of the hive are lengthening their hexagonal tubes, others are laying the foundations of new ones. In certain circumstances, when extremely hurried, they do not complete their new cells, but leave them imperfect till they have begun a number sufficient for their present exigencies. When a bee puts its head a little way into a cell, we easily perceive it scraping the walls with the points of its teeth, in order to detach such useless and irregular fragments as may have been left in the work. Of these fragments the bee forms a ball about the size of a pin's head, comes out of the cell, and carries this wax to another part of the work where it is wanted. It no sooner leaves the cell, than it is succeeded by another bee, which performs the same office; and in this manner the work is successively carried on till the cell is completely polished.

Their mode of working, and the disposition and division of their labour, when put into an empty hive, do much honour to the sagacity of bees. They immediately begin to lay the foundations of their combs, which they execute with surprising quickness and alacrity. Soon after they begin to construct one comb, they divide into two or three companies, each of which in different parts of the hive is occupied in the same operations. By this division of labour, a great number of bees have an opportunity of being employed at the same time, and, consequently, the common work is sooner finished. The combs are generally arranged in a direction parallel to each other. An interval or street between them is always left, that the bees may have a free passage, and an easy communication with the different combs, in the hive. These streets are just wide enough to allow two bees to pass one another. Beside these parallel streets, to shorten their journey when working, they leave several cross passages, which are always covered.

They are extremely solicitous to prevent insects of any kind from getting admittance into their hives. To accomplish this purpose, and in order to shut out the cold, when they take possession of a new hive, they carefully examine every part of it; and if they discover any small holes or chinks, they immediately paste them firmly up with a resinous substance which differs considerably from wax. This substance was known to the antients by the name of *propolis* or bee-glue. Bees use the propolis for rendering their hives more close and perfect, in preference to wax, because it is more durable, and more powerfully resists the vicissitudes of weather. This glue is not, like the wax, procured by an animal process. The bees collect it from different trees, as the poplars, the birches, and the willows. It is a complete production of nature, and requires no addition or manufacture from the animals by which it is employed. After a bee has procured a quantity sufficient to fill the cavities of its two hind-legs, it repairs to the hive. Two of its companions instantly draw out the propolis, and apply it to fill up such chinks, holes, or other deficiencies, as they find in their habitation. But this is not the only use to which bees apply the propolis. They are extremely solicitous to remove such insects or foreign bodies as happen to get admission into the hive. When so light as not to exceed their powers, they first kill the insect with their stings, and then drag it out with their teeth. But it sometimes happens that an ill-fated snail creeps into the hive. This is no sooner perceived than it is attacked on all sides and stung to death. But how are the bees to carry out so heavy a burthen? Such a labour would be in vain. To prevent the noxious odours consequent on its putrefaction, they immediately after the animal's death embalm it, by covering every part of its body with propolis, through which no effluvia can escape. When a snail with a shell gets entrance, to dispose of it gives much less trouble and expence to the bees. As soon as it receives the first wound from a sting, it naturally retires within its shell. In this case, the bees, instead of pasting it all over with propolis, content themselves with glueing all round the margin of the shell; which is sufficient to render the animal for ever immoveably fixed.

But propolis, and the materials for making wax, are not the only substances that these industrious animals have to collect. As, besides the whole winter, there are many days in summer in which the bees are prevented by the weather from going abroad in quest of provisions; they are, therefore, under the necessity of collecting and amassing in cells destined for that purpose large quantities of honey. This they extract, by means of their trunk, from the nectariferous glands of flowers. The trunk of the bee is a kind of rough cartilaginous tongue. After collecting a few small drops of honey with this, the animal carries them to its mouth, and swallows them. From the gullet they pass into the first stomach, which is more or less swelled in proportion to the quantity of honey it contains. When empty, it has the appearance of a fine white thread: but, when filled with honey, it assumes the figure of an oblong bladder, the membrane of which is so thin and transparent, that it allows the colour of the liquid it contains to be distinctly seen. This bladder is well known to children who live in the country: they cruelly amuse themselves with catching bees, and tearing them asunder in order to suck the honey. The bees are obliged to fly from one flower to another till they fill their first stomachs. When they have accomplished this, they return directly to the hive, and disgorge in a cell the whole honey they have collected. It not unfrequently happens, however, that on its way to the hive the bee is accosted by a hungry companion. How the one manages to communicate its wants to the other, it is perhaps impossible to discover. But the fact is certain, that, when two bees meet in this situation, they mutually stop, and the one whose stomach is full of honey extends its trunk, opens its mouth, and, like a ruminating animal, forces up the honey into that cavity. The hungry bee, with the point of its trunk, sucks the honey from the other's mouth. When not stopped on the road, the bee proceeds to the hive, and in the same manner offers its honey to those who are at work, as if it meant to prevent the necessity of quitting their labour in order to go in quest of food. In bad weather, the bees feed on the honey laid up in open cells; but they never touch these reservoirs when their companions are enabled to supply them with fresh honey from the fields. But the mouths of those cells which are destined for preserving honey during winter they always cover with a lid or thin plate of wax *.

How numerous soever the multitude of bees in one swarm may appear, they all originate from a single parent. It is indeed surprising, that one small insect should in a few months give birth to so many young; but, on opening her body at a certain time of the year, eggs to the number of many thousands are to be found contained in it.

The queen is easily distinguished from the rest by the size and shape of her body; on her depends the welfare of the whole community; and by the attention that is paid to all her movements, it is evident how much they depend on her security: she is seen at times

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* Reaumur.

with a numerous retinue, marching from cell to cell, plunging the extremity of her body into many, and leaving an egg in each.

A day or two after this is deposited, the grub is excluded from the shell, having the shape of a maggot rolled up in a ring, and lying softly on a bed of a whitish-coloured jelly, on which it begins to feed. The common bees then attend with astonishing tenderness and anxiety: they furnish it with food, and watch over it with unremitting assiduity. In about six days the grub arrives at its full growth, when its affectionate attendants shut up the mouth of its apartment with wax, to secure it from injury. Thus inclosed, it soon begins to line the walls of its cell with a silken tapestry, in which it undergoes its last transformation.

When it first crawls forth a winged insect, it is very weak and inactive, but in the course of a few hours it acquires strength enough to fly off to its labour. On its emerging from the cell, the officious bees flock round it, and lick up its moisture with their tongues. One party bring honey for it to feed upon; and another is employed in cleansing the cell, and carrying out the filth to prepare this for a new inhabitant.

The neuter bees in a hive amount to the number of 16,000 or 18,000. These are armed with stings, and form the only labouring part of the community. It is pleasant to see them in the act of collecting the farina of flowers for the basis of their wax. They roll themselves over the stamina, the dust of which adheres to their hairs; then, bringing their feet over their bodies, they fill with it two small baskets or cavities edged with hairs, appended to their hind-legs. As soon as a bee thus laden appears near the hive, others go out to meet it, and, taking the farina from its legs, swallow it; their stomachs being the laboratory where it is converted into genuine wax. This operation being over, each individual disgorges it in the consistency of dough, and then moulds it into proper form *.

The males are called Drones: they are unarmed, and are always killed by the neuters about the months of September.

Heat is the life of these insects; the least degree of cold benumbs them; and in winter unless they are all crowded together they perish. Their enemies are the Wasp and the Hornet, who with their teeth rip them open to suck out the honey contained in their bladder. Sparrows have also been seen with one in their bill, and another in each claw.

The queen bee has a sting, but she is not easily compelled to use it. If she happens to die, all the labours of the community are at an end: but if a new queen be given them, joy springs up; even the prospect of seeing one will support them. This has been tried by giving the chrysalis of a queen to a hive that had lost its own.

In Warder's Monarchy of Bees, we have an interesting account of the reciprocal affection subsist-

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* Barbut's Genera Insectorum.

ng between the queen and the working bees: this we shall abridge, as he states himself to have been a witness to the fact.

"Many years ago I wished to satisfy my curiosity respecting the queen bee, and was resolved to hazard the destroying of at least a single swarm of bees for that purpose. I therefore, one morning, about half an hour before sun-rise, took a swarm of bees that had been hived the morning before, and carried it into a meadow near my garden, and there with a smart stroke upon the ground shook out all the bees in a lump upon the grass; and as soon as they were a little settled from the disturbance that so violent a motion produced among them, I laid down on the ground, and with a little stick gently stirred among them in order to find the queen. I at length discovered her, and, shutting her in a box that I had ready for the purpose, carried her into my room; where opening it, I let her fly, and a few of the other bees that I had taken along with her. They, as was natural, flew against the window. I therefore cut off one of her wings, and again shut her up in the box.

"I was now desirous to know how the other bees would act in the absence of their queen. This I soon observed. As soon as they had discovered that she was not amongst them, they, instead of being, as they always were when she was present, collected together in a close bunch, were now scattered about in all directions, running up and down, with a most discontented and piteous note, in search of her. They spent about an hour in this fruitless search;

after which they took wing, and alighted on a hedge at a little distance. This was the hedge on which the same swarm had pitched the day before; and it almost appeared as though they had gone there to search for her in a place where they recollected having been, but a little time before, in company with her. And now, instead of all collecting together in a bunch, they scattered themselves along the hedge for many yards, in little bunches of forty or fifty together.

"I took the box from my pocket, being desirous of knowing whether they would again acknowledge their crippled sovereign. I had no sooner opened the box, and laid it, and the queen along with it, on the bank, near one of these little bunches, than they all immediately collected round it. Having thus found their queen again, they now continued in a cluster about her, and seemed all perfectly contented and happy.

"Night coming on, I again hived them, and the next morning again knocked them out on the grass in the meadow as before; when they soon united themselves together about their sovereign. In this state I suffered them to lie for some hours, to observe whether they would rise; but in this was the strength of their loyalty fully evinced. The poor queen not being able to lead them to any place for their common preservation, her subjects chose rather to perish with her than to forsake her in distress.

"I once again shut up the queen in the box; when the other bees, as before, spread themselves in every direction in search of her. When they were in this situation, I put her down on one side of them: they all in a moment ceased their search, and marched immediately towards her. Before she was quite concealed I took her up, and put her in another place. They then all turned directly to her again. After going through the same experiment a few times more, I suffered them to close round her. They continued in this affecting situation for the remainder of the day, not one of them deserting her, though by this time no doubt they must have been very much in want of food. In the evening I hived them as before.

"On knocking them out on the grass the next morning, I formed a resolution to try to what length these loyal creatures would carry their affection. They had now tasted no food for two days: and their queen had at least equalled them in this; for, though I had several times offered her honey, she would not so much as taste it without her subjects. But to draw this curious though melancholy narrative to a conclusion, I must observe that they still retained their integrity, and even famine itself could not lessen their affection; for, having lived five days and nights without the least food, they all died of hunger. The queen bee existed indeed a few hours longer than the rest, but at length surrendered a life which was comfortless and insupportable to her after the destruction of her friends."

Mr. Wildman, whose remarks on the management of bees are well known, possessed a secret by which he could at any time cause a hive of bees to swarm upon his head, shoulders, or body, in a most surprising manner. He has been seen to drink a glass of wine with the bees all over his head and face more than an inch deep—several fell into the glass, but they knew him too well to sting him. He could even act the part of a general with them, by marshalling them in battle array upon a large table. There he divided them into regiments, battalions, and companies, according to military discipline, waiting only for his word of command. The moment he uttered the word *march!* they began to march in a very regular manner in rank and file in the manner of soldiers. These his little Lilliputians he also taught so much politeness, that they never attempted to sting any of the numerous company which at different times resorted to admire this singular spectacle.

CARDING BEE*.

The Carding Bees nearly all perish in the winter, a few of the females only surviving. These usually make their appearance early in the spring, as soon as the catkins of the willows are in blossom; upon which at this time they may commonly be seen collecting honey from the female, and pollen from the male catkins.

The neuters do not appear till the spring is somewhat advanced; and the males are most common in autumn, when the thistles are in blossom, upon the flowers of which they are abundant, sometimes seemingly asleep, or torpid, and at other times acting as if intoxicated with the sweets they have been imbibing.

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* Apis Muscorum. Linn.

When these animals, of any sex, are walking on the ground, if a finger be moved to them, they lift up the three legs on one side, by way of defence; which gives them a very grotesque appearance.

Their nests are usually formed in meadows and pastures, sometimes in groves and hedge-rows, where the soil is entangled with roots; but now and then these are found in heaps of stones. When they do not meet with an accidental cavity ready made, they excavate one themselves with great labour. This they cover with a thick convex vault of moss, sometimes casing the interior surface with a kind of coarse wax to keep out the wet. At the lower part of the nest is an opening for the inhabitants to go in and out at. This entrance is often through a long gallery or covered way a foot or more in length, by which the nest is more effectually concealed from observation.

The mode in which they transport the moss they use to their nest is singular. When they have discovered a parcel fitted to their purpose, and conveniently situated, they place themselves in a line, with their back turned towards the nest. The foremost lays hold of some with her jaws, and clears it bit by bit with her fore feet: when this is sufficiently disentangled, she drives it with her feet under her belly, and as far as possible beyond, to the second. The second in like manner pushes it on to the third, and so on. Thus small heaps of prepared moss are conveyed to the nest by a file of four or five insects, where they are wrought and interwoven with the greatest dexterity by those that remain within.

The nests are often six or seven inches in diameter, and elevated to the height of four or five inches above the surface of the ground. When the covering of moss is taken up, an irregular comb presents itself, composed of an assemblage of oval bodies disposed one against another. Sometimes there are two or three combs, placed on one another but not united. These combs vary in size: they consist of a number of oblong or oval cells or coccoons, of a silky substance, fastened together, and spun by the larvæ when they are about to undergo their first change; for the Carding Bees do not form waxen cells for their young. The cells are of three dimensions, answering to the three sexes. The void spaces between the cells are filled with masses of brown paste, made of gross wax, or pollen much wrought, and honey. Besides the masses they attach to every comb, particularly the uppermost, three or four cells of the same coarse wax in the shape of goblets open at the top, which they fill with liquid and very sweet honey.—The first step towards furnishing a nest is to make a mass of the brown paste, and one of these honey-pots. The masses of paste are intended for the food of the larvæ, and in them the eggs are deposited. These vary in number, from three to thirty being to be found in one mass, but not all in the same cavity.

The larvæ are similar to those of the Hive Bee, but their sides are marked by irregular transverse black spots. These, after they are hatched, separate from each other, eating the paste that surrounds them. The honey-pots may be intended to supply honey for the occasional moistening of the paste in making repairs, &c. The pupa in each cell is placed with its head downwards, and makes its way out at the bottom of its coccoon.

The nests seldom contain more than fifty or sixty inhabitants. Of these the females (of which there is more than one in a nest) are the largest: the males are of a middle size, as is also one description of working-bees or neuters; the other neuters are the smallest, and not bigger than the Hive Bee. These two sorts of neuters, it is most probable, are appropriated to different kinds of work; the largest being the strongest, and the others the most lively, active, and expert. In this community both the females and males act in concert with the neuters in fitting up or repairing their habitations. These are exposed to the depredations of various foes; but field-mice and polecats are the most formidable to them[*].

ORANGE-TAILED BEE[†].

This is one of the largest of the British bees; but it varies in size, being sometimes half an inch and sometimes an inch in length. Its body is black or dark brown, and hairy, and the extremity of the abdomen of a bright orange colour: the wings are light brown.

The nest constructed by this insect is of a very elegant appearance, being of an oval form, and composed of bits of the larger mosses, very closely and neatly compacted together: a small round hole or entrance is left on one side. These nests are about four inches in diameter on the exterior, and are generally formed on dry shady banks, in woods, lanes, or meadows. The food laid up for the larvæ consists of a kind of honey of a brownish colour, disposed in somewhat irregular masses or heaps; for these bees do not form any regular cells or combs, like some of the others *.

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[*] Kirby, i. p. 201.—Reaumur, tom. vi.

[†] SYNONYMS. — Apis lapidaria. *Linn.*——Red-tailed Bee. Great Orange-tailed Garden Bee, *Shaw's Nat. Mis.*

THE ANTS.

ALL the species of Ants known in this country are gregarious, and, like the bees, consist of males, females, and neuters, of which the latter are alone the labourers. These build in the ground an oblong nest, in which there are various passages and apartments. In the formation of this nest every individual is occupied: some are employed in securing a firm and durable ground-work by mixing the earth with a sort of glue produced in their bodies: others collect little bits of twigs to serve as rafters, which they place over their passages, to support the covering: others again lay pieces across these, and place on them rushes, weeds, and dried grass. The

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* Shaw's Nat. Mis. vol. xii. tab. 454.

latter they secure so firmly as completely to turn off the water from their magazines.

A gentleman of Cambridge one day observed an Ant dragging along what, with respect to its strength, might be denominated a piece of timber. Others were severally employed each in its own way. Presently this little creature came to an ascent, where the weight of the wood seemed for a while to overpower him: he did not remain long perplexed with it; for three or four others, observing his dilemma, came behind and pushed it up. As soon, however, as he had got it on level ground, they left it to his care, and went to their own work. The piece he was drawing happened to be considerably thicker at one end than the other. This soon threw the poor fellow into a fresh difficulty: he unluckily dragged it between two bits of wood. After several fruitless efforts, finding it would not go through, he adopted the only mode that even a man in similar circumstances could have taken; he came behind it, pulled it back again and turned it on its edge; when running again to the other end, it passed through without the least difficulty.

The same gentleman says, that sitting one day after dinner in the garden of his college, he was surprised by remarking a single Ant busily employed in some work that caused him to make many journeys to and from the same place. This gentleman traced him to the entrance of the habitation of a community, from whence he observed him to take the dead body of an Ant in his fangs, and run away with it. He carried it to a certain distance, dropped it, and returned for another, which by the time of his arrival was brought to the same hole. This work was continued so long as the gentleman had time to remain near them *.

In collecting their stores these creatures may often be observed in full employment; one of them loaded with a grain of wheat, another with a dead fly, and several together hawling along the body of some larger insect. Whenever they meet with any food too large to admit of being dragged away, they devour so much of it upon the spot as to reduce it to a bulk sufficiently small for them to carry.

In all their excursions they have some object in view; and they very seldom return to the nest without either themselves bearing something, or without news that something of use has been discovered in which joint assistance is necessary. If information is brought that a piece of sugar, or bread, or any kind of fruit, has been discovered even in the highest story of [illegible] house, they range themselves in a line, and follow their leader to the spot. Of this the following is [illegible] remarkable instance related by Dr. Franklin. Believing that these little creatures had some means of communicating their thoughts or desires to one another, he tried several experiments with them, all of which tended to confirm his opinion; but one seemed more conclusive than the rest. He put a little earthen pot containing some treacle into a

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* Brit. Mus. MSS. Rev. Mr. Ayscough's Catalogue, No. 4436.
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closet, into which a number of Ants got, and devoured the treacle very quietly. But on observing this, he shook them out, and tied the pot with a thin string to a nail which he had fastened into the ceiling; so that it hung down by the string. A single Ant by chance remained in the pot: this Ant ate till it was satisfied; but, when it wanted to get off, it could not for some time find a way out. It ran about the bottom of the pot, but in vain: at last it found, after many attempts, the way to the ceiling by going along the string. After it was come there, it ran to the wall, and from thence to the ground. It had scarcely been away half an hour when a great swarm of Ants came out, got up to the ceiling, and crept along the string into the pot, and began to eat again. This they continued till the treacle was all eaten; in the mean time one swarm running down the string, and the other up.

The Ants generally lay up a considerable quantity of different kinds of grain; but to prevent this from taking root from the moisture of their cells, they instinctively bite off that end from which the blade is produced.

From their eggs, the larvæ, a small kind of maggots without legs, are hatched, which soon transform into white chrysalids. These are generally called *Ant's eggs*, and are frequently used for the feeding of young pheasants, partridges and nightingales. When a nest is disturbed, the Ants, with great care, collect all the young that are unhurt, and form a nest for them again. In their confusion they carry off the eggs and larvæ indiscriminately; but as soon as quietness is restored among them, these are carefully separated, and each kind lodged in its own appropriate place.

During the warm season of the year they bring up the maggots nearly to the surface every morning; so that from ten in the morning to about five in the afternoon these may always be found lodged just under the surface of the ground. And if their hills be examined towards eight in the evening, they will be found to have carried them all down: but if rainy weather be coming on, it will even be necessary to dig a foot or two deeper than usual to find them.

In the last change, the insect tears its transparent veil, and thus bursts into life a perfect insect—destitute of wings if a neuter, and winged if male or female. The winged insects are also known by a small erect scale placed on the thread which connects the body and thorax.

The males are much smaller than the females, and seldom frequent the common habitation. All the labour the females undergo is in the laying of eggs; and the cold of the winter season always destroys them. The neuters or labouring Ants, which alone are able to struggle through the cold months, pass these in a torpid state, in which they remain till spring restores to them their wonted activity. They therefore, having no consumption for provisions, lay up no stores for winter.

The labouring Ants pay the utmost attention to the females. Mr. Gould, the author of a small treatise on English Ants, placed a female, that he calls a Queen, of the small Black Ants, in a box, in the sliding cover of which was an opening sufficient for the labourers to pass backwards and forwards, but so narrow as to confine the queen. One part of them was constantly in waiting and surrounded her, whilst others went out in search of provisions. By some misfortune she died. The Ants, as if not apprised of her death, continued their obedience. They even removed her from one part of the box to another, and treated her with the same formality as if she had been alive. This lasted about two months; at the end of which the cover being opened, they forsook the box, and carried her off.

Ants frequently swarm on trees, where they have been supposed to do much injury. But this seems a very unjust charge against them; for in Switzerland they are even compelled to remain in the trees, in order to destroy the caterpillars. This is done by hanging a pouch full of Ants upon a tree, the root of which is smeared with wet clay or pitch to prevent their escape: in consequence of this, they are soon compelled by hunger to seize upon the caterpillars and devour them.

The females and neuters are armed with a sting. The males, besides being smaller than the females, are to be distinguished from these by the largeness of their eyes.

We are told that a very grateful acid is to be obtained from Ants by distillation: and we have one instance of a person being fond of eating them alive. As Mr. Consett was walking with a young gentleman in a wood near Gottenburg in Sweden, he says *he observed him* sit down on an ant-hill, and with a great degree of pleasure devour these insects, first nipping off their heads and wings. The flavour, according to his account, was an acid somewhat resembling, though much more agreeable than that of a lemon*.

It is said that the Ants of the *tropical climates* are never torpid; that they build their nests with a dexterity, lay up provisions, and submit to regulations entirely unknown among those of Europe. They are in every respect a much more formidable race. Their stings produce insupportable pain, and their depredations do infinite mischief. Sheep, hens, and even rats, by loitering too near their habitations, are often destroyed by them. Bosman informs us, that while he was in Guinea they have often attacked one of his sheep in the night; in which case the poor animal was invariably destroyed: and so expeditious were they in their operations, that in the morning the skeleton only would be left. It sometimes happens that they quit their retreat in a body, and go all together in search of prey.

"During my stay (says Smith) at Cape Coast Castle, a body of Ants came to pay us a visit in our fortification. It was about day-break when the advanced guard of this famished crew entered the chapel, where some negro servants were asleep on the floor. They were quickly alarmed at the invasion of this unexpected army, and prepared as well as they could for a defence. While the foremost battalion had already taken possession of the place, the rear guard was more than a quarter of a mile distant. The whole ground seemed alive, and crawling with immediate destruction. After deliberating a few minutes on what was to be done, it was resolved to lay a large train of gunpowder along the path they had taken. By these means millions were blown to pieces, and the rest, seeing the destruction of their leaders, thought proper instantly to return to their original habitation."

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* Consett, 118.

Dampier, speaking of the natural productions in the Spanish settlements of South America, says, that there were swarms of different species of Ants. "The great black ant stings or bites almost as bad as a scorpion; and next to this the small yellow ants' bite is most painful; for their sting is like a spark of fire; and they are so thick among the boughs in some places, that one shall be covered with them before he is aware. These creatures have nests on great trees, placed on the body between the limbs: some of their nests are as big as a hogshead. This is their winter habitation; for in the wet season they all repair to these their cities, where they preserve their eggs.

"In the dry season when they leave their nests they swarm all over the woodlands; for they never trouble the savannahs: you may then see great paths made by them in the woods of three or four inches broad, beaten as plain as the roads in England. They go out light, but bring home heavy loads on their backs, all of the same substance, and equal in bigness. I never observed any thing besides pieces of green leaves, so big that I could scarcely see the insect for his burthen; yet they would march stoutly, and so many were pressing forward, that it was a very pretty sight, for the path looked perfectly green with them.

"There was one sort of ants of a black colour, pretty large, with long legs: these would march in troops, as if they were busy in seeking somewhat; they were always in haste, and always followed their leaders let them go where they would: these had no beaten paths to walk in, but rambled about like hunters. Sometimes a band of these ants would happen to march through our huts, over our beds, or into our pavilions, nay sometimes into our chests, and there ransack every part; and wherever the foremost went, the rest all came after. We never disturbed them, but gave them free liberty to search where they pleased; and they would all march off before night. These companies were so great that they would be two or three hours in passing by, though they went very fast."

The following is an account of three different kinds of ants that were observed in New South Wales by the gentlemen in the expedition under captain Cook:

"Some are (says the writer) as green as a leaf, and live upon trees, where they build their nests of various sizes, between that of a man's head and his fist. These nests are of a very curious structure: they are formed by bending down several of the leaves, each of which is as broad as a man's hand, and glueing the points of them together, so as to form a purse: the viscus used for this purpose is an animal juice which nature has enabled them to elaborate. Their method of first bending down the eaves we had not an opportunity to observe; but we saw thousands uniting all their strength to hold them in this position, while other busy multitudes were employed within, in applying this gluten that was to prevent their returning back. To satisfy ourselves that the leaves were bent and held down by the effort of these diminutive artificers, we disturbed them in their work; and as soon as they were driven from their station, the leaves on which they were employed sprang up with a force much greater than we could have thought them able to conquer by any combination of their strength. But though we gratified our curiosity at their expence, the injury did not go unrevenged; for thousands immediately threw themselves upon us, and gave us intolerable pain with their stings, especially those which took possession of our necks and hair, from whence they were not easily driven. Their sting was scarcely less painful than that of a bee; but, except it was repeated, the pain did not last more than a minute.

" Another sort are quite black, and their operations and manner of life are not less extraordinary. Their habitations are the inside of the branches of a tree, which they contrive to excavate by working out the pith almost to the extremity of the slenderest twig; the tree at the same time flourishing as if it had no such inmate. When we first found the tree, we gathered some of the branches, and were scarcely less astonished than we should have been to find that we had profaned a consecrated grove, where every tree upon being wounded gave signs of life; for we were instantly covered with legions of these animals, swarming from every broken bough, and inflicting their stings with incessant violence.

" A third kind we found nested in the root of a plant, which grows on the bark of trees in the manner of misletoe, and which they had perforated for that use. This root is commonly as big as a large turnip, and sometimes much bigger: when we cut it, we found it intersected by innumerable winding passages, all filled with these animals, by which, however, the vegetation of the plant did not appear to have suffered any injury. We never cut one of these roots that was not inhabited, though some were not bigger than a hazle nut. The animals themselves are very small, not more than half as big as the common red ant in England. They had stings, but scarcely force enough to make them felt: they had, however, a power of tormenting us in an equal if not in a greater degree; for the moment we handled the root they swarmed from innumerable holes, and, running about those parts of the body that were uncovered, produced a titillation more intolerable than pain, except it is increased to great violence *."

THE SUGAR-ANT †.

These ants, which took their name from their ruinous effects on the sugar-cane, first made their appearance in Grenada about thirty years ago, on a

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* Hawkesworth's Account of Cook's firſt Voyage.

† Formica saccharivora. *Linn.*

sugar-plantation at Petit Havre, a bay five or six miles from the town of St. George. From thence they continued to extend themselves on all sides, for several years; destroying in succession every sugar-plantation between St. George's and St. John's, a space of about twelve miles. At the same time colonies of them began to be observed in other parts of the island.

All attempts of the planters to put a stop to the ravages of these insects having been found ineffectual, an act was passed by the legislature, by which the discoverer of any practicable method of destroying them, so as to permit the cultivation of the sugar-cane as formerly, was entitled to *twenty thousand pounds*, to be paid from the public treasury of the island.

Many were the candidates on this occasion, but very far were any of them from having any just claim: considerable sums of money were, however, granted in consideration of trouble and expences in making experiments.

These ants, which were also injurious to several sorts of trees, as the lime, lemon, orange, &c. were of a middle size, and of a dark red colour.—Their numbers were incredible. The roads have been seen covered with them for miles together; and so crowded were they in many places, that the print of the horses' feet would appear for a moment or two, till filled up by the surrounding multitudes. All the other species of ants, although numerous, were circumscribed, and confined to a small spot, in proportion to the space occupied by the sugar-ants, *as a mole-hill* to a mountain.

Their destruction was attempted chiefly by poison, and the application of fire.

Corrosive sublimate and arsenic, mixed with animal substances, was greedily devoured by them. Myriads were thus destroyed, and the more, as they were by these applications rendered so furious as to destroy each other: yet it was found that these poisons could not be laid in sufficient quantities even to give the hundred-thousandth part of them a taste.

The use of fire afforded a greater probability of success. When wood was burnt to the state of charcoal, without flame, and immediately taken from the fire, and laid in their way, they crowded to it in such astonishing numbers as soon to extinguish it, although with the destruction of thousands of them. Holes were therefore dug at proper distances, and a fire made in each of them. Prodigious quantities perished in this way; for the places of those fires when extinguished appeared in the shape of molehills, from the numbers of the dead bodies heaped on them. Nevertheless the ants soon appeared again as numerous as ever.

This calamity, which resisted so long the efforts of the planters, was at length removed by another, which, however ruinous to the other islands in the West Indies, and in other respects, was to Grenada a very great blessing, namely, the hurricane in 1780. Without this it is probable that the cultivation of the sugar-cane in the most valuable parts of that island must have in a great measure been thrown side, at least for some time.

These ants make their nests only under the roots of particular plants and trees, such as the sugar-cane, the lime, lemon, and orange-trees, where they are protected from the winds and rain; and the mischief done by them does not arise from their devouring those plants, but from these lodgments at their roots. Thus the roots of the sugar-cane are somehow or other so injured by them as to be incapable of supplying due nourishment to the plants, which therefore become sickly and stunted, and consequently do not afford juices fit for making sugar in either any tolerable quantity or quality.

By the violence of the tempest, trees and plants (which commonly resist the ordinary winds) were torn out by the roots. The canes were universally twisted about as if by a whirlwind, or torn out of the ground altogether. In the latter case, both the breeding ants and their progeny must have been exposed to inevitable destruction from the deluge of rain which fell at the same time. The number of canes, however, thus torn out of the ground, could not have been adequate to the sudden diminution of the sugar-ants; but it is easy to conceive that the roots of canes which remained on the ground, and the earth about them, were so agitated and shaken, and at the same time the nests were so broken open, or injured by the violence of the wind, as to admit the torrents of rain accompanying it. The principal destruction of the ants is supposed therefore to have been thus effected *.

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* Phil. Tran. vol. xxx. p. 346.

THE OESTRI, OR GAD-FLIES*.

THE mouth in the Oestri is merely a simple aperture. They have two feelers, but no rostrum or beak. The antennæ are short, and consist of three articulations, the last of which is nearly globular. and furnished with a bristle on the fore part: they are placed in two hollows on the front of the head. The face is broad, depressed, vesicular and glaucous, and has been thought to bear some distant resemblance to that of the Ape tribe.

The larvæ are without feet, short, thick, soft and annulate, and are often furnished with small hooks. These lie hid in the bodies of cattle, where they are nourished the whole winter. The perfect insects are to be met with in the summer in most places where horses, cows, or sheep are grazing. Some of them lay their eggs under the skin of cows or oxen, which they pierce for that purpose; others, for the same end, enter the intestines of horses; and others again deposit them in the nostrils of sheep. In these different habitations the respective larvæ reside till full grown, when they let themselves fall to the earth; and generally pass the chrysalid state under cover of the first stone they meet with.

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* The Linnean order DIPTERA commences here.

From the posterior part of the body of the perfect insect issues a wimble of wonderful structure: it is a scaly cylinder composed of four tubes, which draw out like the pieces of a spying-glass: the last of these is armed with three hooks, and is the gimlet with which the insect bores through the tough hide of horned cattle. When the egg is hatched, the grub feeds on the matter issuing from the wound. The nidus forms upon the body of cattle a lump, sometimes above an inch high. When the larva is full grown it breaks through the tumour, and slides down to the ground in the cool of the morning. It then digs itself a burrow, into which it retires. Its skin hardens to a very solid shell, where it is transformed to a chrysalis, and afterward to a winged insect. This shell has a small valve at one end, fastened by a very slight ligament; without which, so careful is nature in the preservation of her offspring, the insect would not be able to escape from its confinement*.

THE OX GAD-FLY†.

This species of Gad-fly has brown unspotted wings; and the abdomen is marked with a black band in the middle, and has dusky yellow hairs at the tip. The front is white, and covered with down; and the thorax is yellowish before, black in the middle, and cinereous behind. The female differs from the male in having a black style at the end of the abdomen.

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* Barbut's Gen. Insect. 296.

† Oestrus Bovis. *Linn.*

It lays its eggs in the back of the ox; and the larva lives beneath the skin, between this and the cellular membrane. Its sac or abscess is rather larger than the insect, and by narrowing upwards it opens externally to the air by a small aperture.

The larva is smooth, white and transparent when young, but when full grown is of a deep brown. It is also supplied in this state with innumerable minute hooks, ranged in contrary directions on its body, with which, by occasionally erecting or depressing, it is moved about in the abscess; and from this motion, and the consequent irritation, a more or less copious secretion of pus takes place for its sustenance.

When the larva is full grown, it effects its escape from the abscess by pressing against the external opening. When this becomes of sufficient size, it writhes itself through, and falls from the back of the animal to the ground, and, seeking a convenient retreat, becomes a chrysalis. After the exit of the larva, the wound in the skin is generally closed up and healed in the course of a few days.

The Ox Gad-fly is the largest of the European species, and is very beautiful. When the perfect insect leaves the chrysalis, it forces open a very remarkable marginated, triangular lid, which is situated on one side of the small end.

The pain it inflicts in depositing its egg, is much more severe than in any of the other species. When one of the cattle is attacked by this fly, it is easily known by the extreme terror and agitation of the whole herd. The unfortunate object of the attack runs bellowing from among them to some distant part of the heath, or the nearest water, while the tail, from the severity of the pain, is held with a tremulous motion straight from the body, in the direction of the spine, and the head and neck are also stretched out to their utmost length. The rest, from fear, generally follow to the water, or disperse to different parts of the field.

Such is the dread that cattle have of this fly, that, when one of them has met a herd, when almost driven home, they have been known to turn back in the utmost affright, regardless entirely of the stones, sticks and noise of their drivers, and to proceed, without stopping, to some retreat in the water, where they could be secure from its attacks; for the whole of this genus have so strong a dislike to water as never to follow them there.

When the oxen are yoked to the plough, the attack of this fly is attended with real danger, as they become perfectly uncontrollable, and will often run with the plough directly forwards, even through the hedges of the field. To many ploughs there is on this account a contrivance to set them at liberty the moment they are alarmed.

The female fly is very quick in her operation of depositing the egg: she does not remain on the back of the animal more than a few seconds.

The larvæ of this insect are known among the common people by the name of *Wormuls, Wormuls, Warbles,* or *Bots*[*].

THE HORSE GAD-FLY[†].

The larvæ of this fly are those which are commonly found in the stomach of horses, and sometimes, though much less frequently, in the intestines. Here they hang in clusters of from half a dozen to more than a hundred, adhering to the inner membrane of the stomach, by means of two small hooks or tentacula at their smaller ends.

When they are removed from the stomach, they will attach themselves to any loose membrane, even to the skin of the hand. To do this they draw back their hooks, which have a joint near their base, almost entirely within their skin, till the two points come close to each other; then, keeping them parallel, they pierce through the membrane, and immediately afterwards expand them in a lateral direction, and by these means they become perfectly fixed.

Their food is probably the chyle, which they take in by a small longitudinal aperture, situated between the hooks.

From their slowness of growth, and the very small quantity of food they require, it has been found extremely difficult to destroy them by any medicine or poison that could be thrown into the stomach. They are, however, not now considered so injurious to horses as they formerly were, and therefore the difficulty of their extirpation seems not a matter of so much consequence as people have imagined.

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[*] Lin. Tran. iii. 291. tab. 23.

[†] Oestrus Equi. *Linn.*

The mode pursued by the parent fly to obtain for its young a situation in the stomach of the horse is very singular:—The female, when the time for laying her eggs is at hand, approaches on the wing that part of the horse where she intends to deposit the egg, with her body nearly upright, and her tail, which is lengthened out for the purpose, bent inwards: she scarcely appears to settle, but merely touches the hair, with the egg held out on the projected point of the abdomen. The egg adheres by means of a glutinous liquor secreted with it. She then leaves the horse, goes to a small distance, and prepares a second egg; then, poising herself before the part, deposits this in the same way. The liquor dries, and the egg becomes firmly glued to the hair: this is repeated by various flies, till 400 or 500 eggs are sometimes placed on one horse.

The inside of the knee is the part on which these flies principally deposit their eggs; and next to this they fix them on the sides, and the back part of the shoulder: but always in places that are liable to be licked by the tongue. When these eggs have remained on the hairs four or five days they become ripe, after which the slightest application of warmth and moisture is sufficient to bring them into life. If at this time the tongue of the horse touches the egg, its lid is thrown open, and a small active worm is produced, which readily adheres to the surface of the tongue, and is from thence conveyed with the food to the

It is however fortunate for the animals, that this insect is exposed to so many hazards, that scarcely one in a hundred arrives at the perfect state of a fly. The eggs when ripe often hatch of themselves, and the larvæ crawl about till they die; others are washed off by the water. When in the mouth of the animal they have to undergo the ordeal of the teeth and mastication; and many pass entirely through the intestines with the food. When the larvæ arrive at full growth, and are voided along with the dung, many are either dropped into mud or water, others are crushed to death by being trod upon, and others are picked up by the birds.

The perfect fly but ill sustains the changes of weather; and cold and moisture, in any considerable degree, are probably often fatal to it.

This Gad-fly is distinguished from the rest of its tribe by having a black band in the middle, and two dots at the tip of its whitish wings. The abdomen is yellow brown, with black spots at the divisions of the segments. The female is more brown than the male, and has her abdomen elongated with a cleft terminal style*.

THE SHEEP GAD-FLY †.

The manner in which the Gad-fly of the Sheep deposits its egg has not been described; nor is it easy, from the obscure and rapid motion of the insect, to discern the exact manner in which this is accomplished. The moment the flies touch the noses of the sheep, they shake their heads, and strike the ground violently with their fore-feet: at the same time holding their noses to the earth they run away, looking about them on every side to see if the flies pursue. They also smell the grass as they go, lest one should be lying in wait for them. If they observe one, they gallop back, or take some other direction. As they cannot, like the horses, take refuge in the water, they have recourse to a rut, or dry dusty road, where they crowd together during the heat of the day, with their noses held close to the ground; which renders it difficult for the fly conveniently to get at the nostril. It is most probably from repeated attacks, and the consequent rubbing against the ground, that the nostril becomes highly inflamed and sore, and occasions their touch to be so much dreaded by the sheep*.

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* Linn. Tran. iii. 298. tab. 23.

† Oestrus Ovis. *Linn.*

THE TIPULÆ OR CRANE-FLIES.

THE Tipulæ in their general form have a great resemblance to the Gnat. They have a very short membranaceous proboscis, the back of which is grooved, and receives a bristle. The feelers are two, incurved, filiform, and longer than the head; and the antennæ are for the most part filiform.

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* Linn. Tran. iii. 313. tab. 23.

The larvæ are without feet, soft, and cylindrical, and those of the larger species feed on the roots of plants, or in the hollows of decayed trees. Both the larvæ and chrysalids of the smaller Tipulæ are found in water, and are very various both in size and colour. Some, like the polypus, are furniſhed with a pair of arms; and others are inclosed in cylindrical tubes open at the ends. The latter swim nimbly, but the others always remain in the holes they have formed in the banks of rivulets. Some of the species spin a silken case round part of their body. Their whole frame is in general so very tender, that a touch alone is often sufficient to crush them.

THE WHEAT-FLY*.

In July 1795, Mr. Marsham had been informed that an insect had made its appearance among the wheat of a friend in Hertfordshire, which threatened much mischief. Some of the ears were brought to him for examination; and on opening those that seemed diseased, he found in many an orange-coloured powder, and in several one or two very minute larvæ of a yellow colour. On applying a magnifier, for they were too minute for examination with the naked eye, he supposed them at that time to be the larvæ of a small species of Musca; but they have since been discovered to belong to this genus. They were thicker at one end than the other; extended and contracted themselves at pleasure; and had in addition a leaping motion, frequently springing full half an inch from the paper on which he examined them. The ears were put into water, with gauze tied round them; but notwithstanding this care the flies escaped, after their developement, without being seen. Mr. Marsham wrote to several friends, requesting their attention to this subject; in consequence of which, an accurate investigation was immediately set on foot.

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* Tipula Tritici. *Linn. Tran.*

It appears that these larvæ take their station in the longitudinal furrow of the grain, to the bottom of which they seem attached. Here probably sucking the milky juice which swells the grain, and thus depriving it of part, and in some cases perhaps of the whole of its moisture, they occasion it to shrink up, and become what the farmers call *pungled*. They infect several grains in the same ear, and some ears have been observed in which even a fourth of the grain was either destroyed, or very materially injured by them. The late sown wheat always appeared the most infected, arising no doubt from the seed of that sown earlier obtaining too great a degree of hardness, before the insects come out, to be liable to be much hurt by them.

The Rev. Mr. Kirby attended very closely to these insects; but it was some time before he was able to discover the parent flies, and still longer before he could find them in sufficient numbers to allow him to make the necessary observations as to their habits and economy.

In the beginning of June 1798, however, he chanced to walk through a corn-field in the evening, and, to his great surprise, observed an innumerable multitude of them flying about in every direction; and for near a month afterwards found them in the greatest abundance. They were seldom seen before seven o'clock; at eight the fields appeared to swarm with them, at which hour they were all busily engaged in laying their eggs; and about nine they generally disappeared. They were so extremely numerous, that if each of them were to lay its eggs in a different floret, and these eggs were permitted to produce larvæ, more than half the grain of the adjacent country would infallibly be destroyed. Twelve have been observed at the same moment laying their eggs in the same ear: but among all these myriads not one male could be discovered. During the day-time none of these insects are to be seen, as they then continue lodged in a state of repose upon the lower part of the culm. Upon shaking the stalks, however, they will fly about.

The female lays her eggs by means of a long retractile tube, which unsheaths an aculeus as fine as a hair and very long.

These insects would soon become of serious injury to mankind, were not their race kept within due bounds by several natural enemies, some of which devour them, and others (*Ichneumon Tipulæ*) deposit their eggs in the larvæ, the young of which, when hatched there, find a proper nourishment in the bodies of their hosts.

This Ichneumon is about the size of the Wheat-fly; and in order to observe the manner of the female's depositing her eggs in the caterpillars of the Wheat-fly, Mr. Kirby placed a number of the latter on a sheet of white paper, and then set an Ichneumon down in the midst of them. She soon discovered one of the larvæ; when vibrating her antennæ in an intense degree she fixed herself upon it, and, bending her body obliquely under her breast, inserted her aculeus into the body of her victim, (which seemed by its motion to experience a momentary pain,) and there deposited a single egg. This being done, she went to a second, which was constrained to undergo the like operation, and so on to all the rest. She never deposited more than one egg in each larva; and when she was remarked to mount one that had been pricked before, she soon discovered her mistake and left it. The size of the two insects is so nearly alike, that one young only can be nourished by a single larva; and therefore instinct teaches the parent Ichneumons to deposit only this number in each.

Mr. Kirby proposes, as an additional remedy for this evil, that, when the wind is in a favourable quarter, the fumes of tobacco or sulphur should be thrown upon the corn. But, if this is done, it should be as soon as the ears begin to appear from the unsheathing leaf of the stalk.

The Wheat-fly is about the twelfth of an inch in length: its body and legs are of a dull yellow, and the wings whitish with a fringed margin *.

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THE FLIES.

THE mouth of the insects of this tribe has a soft

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* Linn. Tran. iii. p. 243.—iv. p. 224. 240.—v. p. 96.

fleshy proboscis with two equal lips: and the sucker is furnished with bristles. The antennæ are generally very short.

The appellation of Fly has been given almost exclusively to these insects, probably from their being so much more common than any others. The larvæ of some of the species live in the water; others are found on trees, where they devour the plant-lice; and others in putrid flesh, cheese, &c. Most of the Flies sleep during the winter, and lay up no provision for their nourishment.—In the decline of the year, when the mornings and evenings become chilly, many of the species come for warmth into houses, and swarm in the windows. At first they appear very brisk and alert; but as they grow torpid they are seen to move with difficulty, and at last are scarcely able to lift their legs, which seem as if glued to the glass; and by degrees many do actually stick on till they die in the place. It has been observed that some of the flies, besides their sharp, hooked nails, have also skinny palms or flaps to their feet, whereby they are enabled to stick on glass and other smooth bodies, and to walk on ceilings with their backs downward, by means of the pressure of the atmosphere on those flaps; the weight of which they easily overcome in warm weather, when they are brisk and alert. But towards the end of the year this resistance becomes too mighty for their diminished strength; and we see flies labouring along, and lugging their feet in windows as if they stuck fast to the glass; and it is with the utmost difficulty they can draw one foot after another, and disengage their hollow caps from the slippery surface. On a principle exactly similar to this it is that boys, by way of amusement, carry heavy weights, by only a piece of wet leather at the end of a string, clapped close to the surface of a stone.

It is a very extraordinary fact, that flies have been known to remain immersed in strong liquors even for several months, and afterwards, on being taken out, and exposed to the air, have again revived. Some, for instance, as we are told by Dr. Franklin, were drowned in Madeira wine, when bottled in Virginia to be sent to England: at the opening of a bottle of this wine at a friend's house in London many months afterwards, three drowned flies fell into the first glass that was filled. The Doctor says, that having heard it remarked that drowned flies were capable of being revived by the rays of the sun, he now proposed making the experiment. They were therefore exposed to the sun, upon the sieve which had been employed to strain them from the wine. In less than three hours two of them began by degrees to have life. They commenced this by some convulsive motions in the thighs; and at length they raised themselves upon their legs, wiped their eyes with their fore-feet, and very soon afterwards flew away.

THE COMMON FLESH-FLY [*].

This insect is in appearance much allied to the large Blue-bottle flesh-fly [†]. It is however somewhat more slender, and is besides of a greyish tint, occasioned by some irregular, longish stripes on the corcelet running lengthwise, and some still more irregular marks of the same kind on the body, all of them of a cinereous grey, separated by a shining brown, which, under certain points of view, appear of a blueish tint. Its legs are black, the halteres or balancers under its wings are whitish, and its reticular eyes somewhat red.

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[*] Musca carnaria. *Linn.* [†] Musca vomitoria. Linn.

It is a fact not generally known that this is a viviparous insect, depositing its young in a living state on the meat in our shambles and larders. These young appear under the same worm-like form as the grubs produced from the Blue flesh-fly; they feed as those do, increase in size, undergo all their transformations in the same manner, and even in the fly state appear very little different. It appears that the eggs of this fly are extruded from the uterus into the cavity of the abdomen, and there undergo their first change, differing in this respect from most others of the insect tribes.

When the worms have attained their full size (which is generally in seven or eight days) they quit their food, and go in search of some loose earth, in which they bury themselves and undergo their metamorphosis.

Some others of the flies are also viviparous.

THE HESSIAN FLY*?

Among the various causes of alarm experienced by the farmer in the course of his rural labours, few are more powerful, though many more justly so, than the larvæ or grubs of this little fly. These are lodged and nourished in the very heart of the stems of wheat and rye, just above the root, which by their voracity they entirely destroy.

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* Musca Pumilionis. *Linn.*

The fly producing this destructive grub is not quite a fourth of an inch in length: its thorax is dark-coloured, but marked longitudinally with two yellow lines. The grubs are white, about two lines in length, composed of ten rings, with the head pointed at the end. The pupa or chrysalis is yellow, shining, rather more than one line long, and composed of rings.

In order to determine the species of this animal, Mr. Markwick planted some diseased roots of wheat in a small flower-pot filled with bran: this pot he covered over with gauze in such a manner that no insect could get in from the outside, nor could any escape from within. Not very long afterwards he discovered three small flies, which he found to be of this species, sitting on the inside of the gauze, and a few days after three more. There were in the pot six roots of diseased wheat, which thus produced six flies. On examining the roots, he now found an empty chrysalis in each.

The principal stems of the corn being entirely destroyed by this grub, gave the crop of wheat belonging to a friend of Mr. Markwick so disastrous an appearance that scarcely a hope was entertained of any produce: but after the grub had changed into its chrysalis state the mischief ceased, and none of the roots were so materially injured as to prevent them throwing out shoots on each side. At harvest-time it was a matter of most agreeable surprise that this should prove a good crop of wheat, with the ears throughout the field large and well filled. The owner even thought it the best crop on his farm, and conjectured that it would produce about three quarters and a half of threshed corn from each acre.

The wheat that was sown early, about the beginning of October, was only affected by this insect. The reason was, probably, that the cold at the approach of winter had destroyed all the flies before the late sown wheat had time to spring out of the ground: consequently their eggs could not be laid in this. The fly appears to be perfected in May, or the beginning of June.

It was conjectured that this might be the *Hessian fly*, whose depredations in America have been so notorious. If this is the case, Mr. M. is of opinion that a little good English husbandry, by keeping the ground in heart, and thus enabling the wounded shoots to repair themselves by strong lateral ones, will prevent any serious alarms *.

THE CHEESE-FLY †.

The larvæ of these flies are the troublesome maggots found in cheese, so well known to housewives under the name of *Hoppers*. They proceed from the eggs deposited in the crevices or holes of the cheese by a very common fly about the tenth of an inch long, and of a dark colour, with whitish wings, each marked with a black rib.

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* Linn. Tran. ii. p. 76. tab. 15.

† Musca putris. *Linn.*

This maggot is surprisingly strong and vigorous, and leaps to a considerable distance when disturbed. To do this it erects itself on its tail, and, bending its head round into a circle, fixes two black claws at the end of the tail into two cavities formed for their reception at the back of the head: it then exerts its muscular powers, and, in suddenly extending its body, throws itself, for its size, to a vast distance. One of these not a fourth of an inch long has been known to leap thus out of a box six inches deep, or to twenty-four times its own length.

The rottenness of cheese is in a great measure occasioned by these little maggots; for they crumble the substance of it into small particles, and the smallest tainted spot immediately spreads when any of them get upon it.

When they are about to change into chrysalids, they desert the cheese, and in three or four days afterwards grow stiff and lifeless. The fly bursts through an opening in the skin just at the head, which there divides into two parts. At its first appearance its wings are not fully formed, but it is able to run about with great activity: the wings however expand by degrees, and in the course of a quarter of an hour they are perfected.

In the ovary of a single female no fewer than two hundred and fifty-six eggs were found.

THE CHAMÆLEON FLY *.

This is one of our most common two-winged insects. The egg from which it is produced is deposited by the female in the hollow stalks of reeds and other aquatic plants. From this proceeds a larva of singular structure, which is often to be seen crawling on grass and plants near shallow standing waters, or floating near the surface.

The general colour of the larvæ is a greenish brown. Their bodies consist of eleven rings, and their skin somewhat resembles parchment. Though these animals, before their transformation into flies, live in water, air is necessary to support their principle of life; and the apparatus with which nature has furnished them for that important purpose deserves our particular notice. The last ring or termination of their bodies is open, and serves as a conductor of air. From this ring proceed a number of hairs, which, when examined by the microscope, are found to be real feathers with regular vanes. In particular situations they bend the last ring in such a manner as to reach the surface of the water or mud in which they are placed. The feathers prevent the water from entering the tube or organ of respiration; and, when the animal raises the termination of its body to the surface, in order to receive air, it erects and spreads the feathers, and by these means exposes the end of the tube to the atmosphere. When it wishes to descend, it contracts

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* Musca Chamæleon. *Linn.*

the filaments into the form of a ball, and the bubble of air contained within it serves to keep the body in a vertical position.

If this insect is cautiously cut open, two large vessels, or tracheæ, will be seen on each side to occupy almost one half of the body. Both of these terminate in the open tube, or last ring. Though these worms are furnished with powers of respiration, and actually respire air, yet some of them are able to live more than twenty-four hours without respiration.

The head of this creature exhibits not less matter of curiosity than its tail. In the middle part of its mouth is placed a hard, pointed, horny substance, immoveable, and somewhat resembling the upper mandible in the beak of a bird. On each side of this is a small organ. These have lately been discovered to be the feet, or, perhaps more properly, the arms, by which the animal performs many of its movements in the water, and by whose aid alone it can move itself forward on dry land. Another principal use of these members seems to be to loosen the mud for the purpose of allowing the mouth to find easier access into it than it otherwise might do; performing in some measure the same functions in this respect as the gristle in the nose of a hog. The animal has the power of drawing these organs inwards at pleasure, so as to hide them as it were within the cheeks; and from this peculiar position, some persons have said that this larva carries its feet in its mouth.

It is a calm, inoffensive animal; discovers no symptoms of fear when man approaches, and performs in his presence all its usual operations with great tranquillity. It never attempts to injure or annoy any other creature in this state of its existence.

When the time of its metamorphosis approaches, the larva leaves the water, and, climbing up the side of the bank, chooses a place where it can lie only in part immerged in water. Here it remains at rest, until it finally attains its pupa state. From five to ten days are occupied in attaining its complete form, and becoming a fly. This change always takes place about the middle of July.

THE RAT-TAILED WORM FLY*.

The larvæ of the present species are usually found in moist places, such as are frequented by the common black lizard, and they never appear on dry ground till about to undergo their first transformation. In this state they somewhat resemble the tadpole in form, the fore-part being soft, thick, and rounded, and the tail small and tapering. Being covered with a viscous fluid, they are generally found encrusted with a coat of dirt. This seems to be their colour, till they are washed, when they are found of a transparent white.

The parent fly always lays her eggs in a place near the vicinity of water, that is, where it is betwixt moist and dry. M. Reaumur watched the motions of one of these insects, which he saw flying about a bucket of water that stood in his garden. After crossing it several times, she at length descended within its mouth, and, after flying round and round it several times, stopped about an inch above the surface of the water, and laid, in several places, a little cluster of eggs. These were all deposited where the wood was just damp from the influence of the water below, and invariably in cavities between two adjoining staves, where the water was less likely to be dried up than elsewhere. In this situation, the young insect was no sooner extruded from the egg than it found itself within reach of the element where it was destined to pass the most considerable part of its life.

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* Musca pendula. *Linn.*

The young are no sooner dropped into the water than, like all other animals in their natural element, they find themselves endowed with the instinct of searching for their own food, and of employing, in an appropriate manner, all the members of their body to the proper uses for which they are naturally adapted.

The tail of this insect, like that of the last, is its organ of respiration; and though, like the whale, it is an inhabitant of the water, yet it is, like that, a breathing animal, and would be entirely suffocated and drowned, were it to be continued under water and excluded from access to the air.

Reaumur, in order to observe the economy of these little creatures, which he denominated *Rat-tailed Worms*, collected a number of them, which he put into a glass vessel filled two inches high with water. At first they were considerably agitated, each seemingly searching for a proper place of repose. Some of them swam across, others attached themselves to the sides, and others rested at the bottom of the vessel. In a quarter of an hour they were almost all entirely tranquil, and Reaumur soon discovered the real use of their long tails. On examining the vessel, he found that each of the animals, in whatever situation they were placed, extended its tail exactly to the surface; that, like other aquatic insects, the respiration of air was necessary to their existence; and that the tail, which is tubular, and open at the extremity, was the organ by which this operation was performed. In this experiment, the distance from the bottom to the surface was two inches, and, of course, the tails were of an equal length. To discover how far the animals could extend their tails, this most ingenious and indefatigable philosopher gradually augmented the height of the water, and the tails uniformly rose to the surface till it was between five and six inches high. When the water was raised higher, the animals immediately quitted their station at the bottom, and either mounted higher in the water, or fixed themselves upon the sides of the vessel, in situations which rendered it convenient for them to reach the surface with the points of their tails.—These tails consist of two tubes, both of which are capable of extension and contraction. The first tube is always visible; but the second, which is the proper organ of respiration, is exerted only when the water is raised beyond a certain height. Through this tube the air is conveyed into two large tracheæ or wind-pipes within the body of the animal, and thus maintains the principle of life. When the tails are below the surface, the animals occasionally emit small bubbles of air, which are visible to the naked eye, and immediately repair to the surface for fresh supplies.

So anxious is nature to provide animals in every state of their existence with air, that, after the transformation of many insects into chrysalids, she creates instruments for that purpose, which did not exist previous to their transformation. These Rat-tailed Worms, soon after they are transformed into chrysalids, instead of a soft, pliable skin, are covered with a hard crustaceous substance, seemingly impervious to the air; and the tail, which was the wind-pipe of the animal in its first state, gradually vanishes. In a few hours, however, four hollow horns shoot out, two from the fore and two from the hind part of what was the head of the animal. These horns, which are hard and tubular, M. de Reaumur discovered to be real wind-pipes, destined for the introduction of air into the chrysalis; a state in which many animals have the appearance of being almost totally dead, and, of course, should seem to have little use for respiration. He likewise discovered that these horns, which had pierced the hard, exterior covering, terminated in as many tracheæ in the body of the animal. This fact affords a strong example of the necessity of air for sustaining the principle of life, even in its lowest condition. After these animals pass from the chrysalis state to that of flies, they are deprived both of their tails and horns. But nature, in this last stage of their existence, has not left them without proper resources for the introduction of air into their bodies. Instead of protuberant tracheæ in the form of tails or horns, they now, like other flies, receive air by means of stigmata, or holes, variously disposed over different parts of the body.

These Rat-tailed Worms pass the first and longest part of their lives, which is supposed to be several months, under water. When near the time of their transformation, they leave that element, retire into the ground, and there become chrysalids. From this state they are changed into flies, and spend the remainder of their short existence in the air.

THE GNATS.

The mouth of the Gnats has a long slender trunk or flexile sheath inclosing five pointed bristles; it has also two feelers. The antennæ are generally filiform, but those of some of the males are feathered.

They principally frequent woods and watery places, and are known by the country people by the name of *Midges.* They live by sucking the blood and juices of the larger animals.

Their larvæ are very common in stagnant waters: the bodies of these are composed of nine segments, the last of which is furnished with a small cylindrical tube through which they breathe, frequently rising to the surface of the water for that purpose.— The head of the chrysalis is bent down towards the breast, so as to throw the thorax in front: in this the respiratory tubes are near the head. The last segment of the abdomen terminates in a kind of flat fin, by means of which the creature obtains its motion in the water.

THE COMMON GNAT*.

Few insects are better known than this species of Gnat, and there are not many that afford a more interesting history.

From the beginning of May their larvæ may be seen in the stagnant waters, with their heads downwards and the extremity of their abdomen at the surface, from the side of which arises the hollow tube through which they respire. Their heads are armed with hooks, that serve to seize on insects and bits of grass on which they feed: and on their sides are four small fins, by the help of which they swim and crawl along. These larvæ retain their form during a fortnight or three weeks, after which they turn into chrysalids; and all the parts of the winged insect are now distinguishable through their thin exterior covering. The situation and shape of their respiratory tube is also altered: this is now divided into two parts, and is placed near the head. The chrysalids now abstain from eating, and reside almost constantly at the surface of the water; but on the least motion they may be seen to unroll themselves from their spiral position, and, by means of little paddles on their hinder part, to plunge to the bottom. In the course of a few days they are transformed into perfect Gnats. The chrysalids swell at the head, and the flies burst from their inclosure. If at the instant of the change a breeze springs up, it proves to them a dreadful hurricane, as the water gets into their case, from which they are not yet perfectly loosened; this immediately sinks, and they are drowned*.

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* Culex pipiens. *Linn.*

The female deposits her eggs on the surface of the water, and surrounds them with a kind of unctuous matter, which prevents them from sinking; and she at the same time fastens them with a thread to the bottom, to prevent them from floating away, at the mercy of every breeze, from a place the warmth of which is proper for their production, to any other where the water may be too cold, or the animals their enemies too numerous. In this state they therefore resemble a buoy that is fixed by an anchor. As they come to maturity they sink deeper; and at last, when they leave the egg, they creep in the form of grubs at the bottom.

If the Gnats were not devoured by fish, waterfowl, ſwallows, and other animals, the air would often, from their immenſe multitudes, become darkened: a few instances have occurred in which this has been the caſe. In July, August, and September 1766, at Oxford, they were sometimes seen towards the evenings in ſuch myriads as literally to darken the rays of the ſun; and their repeated bites often ſwelled the exposed parts of the body to an enormous size, and caused the most troublesome and unpleasant sensations. Mr. Swinton, who has given an account of them in the Philosophical Transactions, has stated that he was one evening in the garden of Wadham College, about half an hour before sunset, in company with another gentleman, when they were observed in numbers almost unexampled. Six distinct columns were observed to ascend from the tops of ſix branches of an apple-tree in an adjoining garden, separated from that in which they were stationed by a wall at least fifty or sixty feet in height. Two of these columns seemed perfectly erect, three of them were oblique, and one approached somewhat towards a pyramidal form. The bodies of some of these Gnats were greatly distended with blood; one, considerably larger than the rest, that was killed, had as much blood expressed from it as besmeared part of a wall three inches square. About thirty years before this many columns of Gnats were observed to rise from the top of the cathedral church at Salisbury. At a little distance they had so great a resemblance to smoke, as at first to occasion considerable alarm lest the church was on fire*.

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* Barbut's Gen. Insect. 306.

It is impossible to behold and not to admire the beautiful ſtructure of the proboscis of the Gnat, through which it draws the juices that afford it nourishment. The naked eye is only able to discover a long and slender tube, containing five or six spiculæ of exquisite fineness. These spiculæ, introduced into the veins of animals, act like the suckers of a pump, and cause the blood to ascend. The insect injects a small quantity of liquid into the wound, by which the blood is made more fluid. The animal swells, grows red, and does not quit its hold till it has gorged itself. The liquor it has injected causes, by its fermenting, a disagreeable itching, which may be removed by volatile alkali, or immediately rubbing and washing with cold water*.

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* Swinton in Phil. Tran. vol. lvii. p. 111.

At night to rub the part affected with fuller's earth and water, it is said, will lessen the inflammation.

Gnats are said sometimes to shine in the dark.

The Musqueto-fly is nothing more than a large variety of the Common Gnat, which is very common in the woody and marshy parts of all hot climates. Its bite is so severe as to swell and blister the skin in a most violent manner, and sometimes even to leave obstinate sores. Seeking its food principally in the night, it disturbs the rest of persons nearly as much by the buzzing noise it makes with its wings, as by its bite. The poor inhabitants of some of the low parts of the West-India islands are under the necessity of burning a continual fire in their huts, by the smoke of which these insects are effectually kept at a distance; but persons who can afford it ſleep under nets of thin gauze.

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* Barbut's Gen. Insect. 306.

THE TERMES TRIBE[*].

THE present tribe is arranged by Linnæus among the apterous insects: but it might with equal propriety have been inserted with the Neuroptera or Hymenoptera; for most of the species, in a perfect state, have either two or four wings.

The mouth is furnished with two horny jaws, and has a horny four-cleft lip: the feelers are four, thread-shaped, and equal. The antennæ in some of the species are beaded, and in others tapering.

THE DEATH-WATCH TERMES[†].

This insect is about a tenth of an inch long, with sharply pointed and somewhat long antennæ. At first sight it has greatly the appearance of a Louse: its mouth however with a glass is seen to be reddish, and its eyes are yellow. It is sometimes, though very rarely, winged.

It is usually found in old wood, decayed furniture, museums and neglected books; and both the male and female have the power of making a ticking noise, not unlike that of a watch, to attract each other. These little animals are in considerable numbers during the summer months; but, when disturbed, they run so nimbly into a hiding-place as not often to be remarked. When they are disturbed, they are very shy in making their noise; but if they can be viewed without being alarmed by noise, or moving the place where they are, they will not only beat freely, but even answer any person's beating with his nail. At every stroke their body shakes, or seems affected as by a sudden jerk; and these jerks succeed each other so quickly, that it requires great steadiness to perceive with the naked eye that the body has any motion whatever. They are scarcely ever heard to beat before July, and never later than the sixteenth of August. It appears strange that so small an animal should be able to make a noise so loud as is frequently to be heard from this; sometimes equal to that of the strongest beating watch. Dr. Derham seems to have been the first naturalist who examined and described this species. He had often heard the noise, and in pursuing it had found nothing but these insects, which he supposed incapable of producing it; but one day, by finding that the noise proceeded from a piece of paper loosely folded, and lying in a good light in his study window, he viewed it through, and with a microscope observed, to his great astonishment, one of them in the very act of beating. In some years they are more numerous than others, and their ticking is of course more frequently heard: Dr. Derham says, that during the month of July, in one particular summer, they scarcely ever ceased, either in the day or night.

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[*] The Linnean genus of APTEROUS INSECTS commences with this tribe.

[†] Termes pulſatorium. *Linn.*

The female lays her eggs in dry and dusty places, where they are likely to meet with the least disturbance: these are exceedingly small, and are not unlike the nits or eggs of lice. They are generally hatched about the beginning of March, or a little sooner or later according to the weather. After leaving the egg, the animals are so small as scarcely to be discerned without the assistance of a glass. They continue in this larva state about two months, somewhat resembling in appearance the mites in cheese; after which they undergo their change.

They feed on dead flies and other insects, and, from their numbers and voracity, often very much deface cabinets of natural history. They also live on various other substances, and may often be observed hunting for nutritious particles, with great care and attention, among the dust in which they are found: turning it over with their heads, and searching among it somewhat in the manner of swine. Many of them live through the winter; but during that time, in order to avoid the inconveniences of frost, they bury themselves deep in dust*.

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* Phil. Tran. vol. xxvi. p. 231.

THE WHITE ANTS*.

The animals of this extraordinary community are found in the East Indies, and many parts of Africa and South America, where their depredations are greatly dreaded by the inhabitants. Mr. Smeathman, whose account of them occupies above fifty pages in the seventy-first volume of the Philosophical Transactions, says, that they are naturally divided into three orders: 1. The working insects, which he distinguishes by the name of *labourers*; 2. The fighters or *soldiers*, which perform no other labour than such as is necessary in defence of the nests; and, 3. The winged or perfect insects, which are male and female, and capable of multiplying the species. These last he calls the *nobility* or *gentry*; because they neither labour nor fight.

In a nest or hill, for they build on the surface of the ground, the labourers are always the most numerous. There are at least a hundred labourers to one of the fighting insects or soldiers. When in this state, they are about a fourth of an inch in length; which is rather smaller than some of our ants.

The second order, or soldiers, differ in figure from the labourers. These appear to be such insects as have undergone one change towards their perfect state. They are now about half an inch in length, and equal in size to about fifteen of the labourers.

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* Termes fatale. *Linn.*

The form of the head is likewise greatly changed. In the labourer state, the mouth is evidently formed for gnawing, or for holding bodies: but, in the soldier state, the jaws, being shaped like two sharp awls a little jagged, are destined solely for piercing or wounding. For these purposes they are well calculated; being as hard as a crab's claw, and placed in a strong horny head, which is larger than the whole body.

The insect of the third order, or in its perfect state, is still more remarkable. The head, the thorax, and the abdomen, differ almost entirely from the same parts in the labourers and soldiers. The animals are besides now furnished with four large, brownish, transparent wings, by which they are enabled, at the proper season, to emigrate, and to establish new settlements. They are now also greatly altered in their size as well as their figure, and have acquired the powers of continuing the species. Their bodies now measure near three quarters of an inch in length, their wings, from tip to tip, above two inches and a half, and their bulk is equal to that of thirty labourers, or two soldiers. Instead of active, industrious, and rapacious little animals, when they arrive at their perfect state they become innocent, helpless, and dastardly. Their numbers are great, but their enemies are still more numerous: they are devoured by birds, by every species of ants, by carnivorous reptiles, and even by the inhabitants of many parts of Africa. After such devastation it seems surprising that even a single pair should escape. "Some however," says Mr. Smeathman, "are so fortunate; and being found by some of the labouring insects, that are continually running about the surface of the ground under their covered galleries, are *elected* Kings and Queens of new states: all those who are not so elected and preserved, certainly perish. The manner in which these labourers protect the happy pair from their innumerable enemies, not only on the day of the massacre of almost all their race, but for a long time after, will, I hope, justify me in the use of the term election. The little industrious creatures immediately inclose them in a small chamber of clay suitable to their size, into which at first they leave but one entrance, large enough for themselves and the soldiers to go in and out at, but much too little for either of the royal pair to use; and when necessity obliges them to make more entrances, they are never larger; so that, of course, the voluntary subjects charge themselves with the task of providing for the offspring of their sovereigns, as well as of working and fighting for them, until they have raised a progeny capable at least of dividing the task with them."

About this time a most extraordinary change takes place in the queen: the abdomen begins to extend and enlarge to such an enormous size, that an old queen will sometimes have it so much increased as to be near *two thousand times* the bulk of the rest of her body. The skin between the segments of the abdomen extends in every direction; and at last the segments are removed to the distance of half an inch from each other, though at first the whole length of the abdomen was not half an inch. When the insect is upwards of two years old, the abdomen is increased to three inches in length, and it is sometimes seen near twice that size. It is now of an irregular oblong shape, and is become one vast matrix full of eggs, which make long circumvolutions through an innumerable quantity of very minute vessels, that circulate round the inside in a serpentine manner. When the eggs are perfectly formed, they begin to be protruded, and they come forth so quickly, that about sixty in a minute, or upwards of eighty thousand in twenty-four hours, are deposited.

These eggs are immediately taken away by the attendants, and carried to the nurseries. Here they are hatched. The young are attended and provided with every thing necessary, until they are able to shift for themselves, and take their share in the labours of the community.

The nests, or rather *hills*, of these Ants, for they are often elevated ten or twelve feet above the surface of the ground, are nearly of a conical shape; and sometimes so numerous, as at a little distance to appear like villages of the negroes. Jobson, in his History of Gambia, says that some of them are twenty feet high, and that he and his companions have often hidden themselves behind them, to shoot deer and other wild animals. Each hill is composed of an exterior and an interior part. The exterior cover is a large clay-shell, shaped like a dome, of strength and magnitude sufficient to inclose and protect the interior building from the injuries of the weather, and to defend its numerous inhabitants from the attacks of natural or accidental enemies.

These hills make their first appearance in the form of conical turrets about a foot high. In a short time the insects erect, at a little distance, other turrets, and go on increasing their number and widening their bases, till their underworks are entirely covered with these turrets, which the animals always raise highest in the middle of the hill; and, by filling up the intervals between each, they collect them, at last, into one great dome.

The royal chamber is always situated as near the centre of the building as possible, and is generally on a level with the common surface of the ground. It is always nearly in the shape of half an egg, or an obtuse oval, within, and may be supposed to represent a long oven. In the infant state of the colony, it is not above an inch in length; but in time it becomes increased to six or eight inches, or more, being always in proportion to the size of the queen, who, increasing in bulk as in age, at length requires a chamber of such dimensions.

The entrances into the royal chamber not admitting any animal larger than the labourers or soldiers, it follows that the king and queen can never possibly get out. This chamber is surrounded by an innumerable quantity of others, of different sizes, figures, and dimensions; all of them arched either in a circular or an elliptical form. These chambers either open into each other, or have communicating passages, which, being always clear, are evidently intended for the convenience of the soldiers and attendants, of whom great numbers are necessary. These apartments are joined by the magazines and nurseries. The magazines are chambers of clay, and are at all times well stored with provisions, which, to the naked eye, seem to consist of the raspings of wood and plants which the Ants destroy; but, when examined by the microſcope, they are found to consist chiefly of the gums or inspissated juices of plants, thrown together in small irregular masses. Of these masses, some are finer than others, and resemble the sugar about preserved fruits; others resemble the tears of gum, one being quite transparent, another like amber, a third brown, and a fourth perfectly opaque.

The magazines are always intermixed with the nurseries, buildings totally different from the rest of the apartments. These are composed entirely of wooden materials, which seem to be cemented with gums. They are invariably occupied by the eggs and the young, which first appear in the shape of labourers. These buildings are exceedingly compact, and are divided into a number of small irregular-shaped chambers, not one of which is half an inch wide. They are placed all round, and as near as possible to the royal apartments.

When a nest is in an infant state, the nurseries are close to the royal apartment. But, as in process of time the body of the queen enlarges, it becomes necessary, for her accommodation, to augment the dimensions of her chamber. She then, likewise, lays a greater number of eggs, and requires more attendants: of course, it is necessary that both the number and dimensions of the adjacent apartments should be augmented. For this purpose, the small first built nurseries are taken to pieces, rebuilt a little farther off, and made a size larger, and their number, at the same time, is increased. Thus the animals are continually employed in pulling down, repairing or rebuilding their apartments; and these operations they perform with wonderful sagacity, regularity and foresight.

The nurseries are inclosed in chambers of clay, like those which contain the provisions; but they are much larger. In the early state of the nest, they are not bigger than an hazel nut; but, in great hills, they are often four or five inches across.

The royal chamber, as we have observed, is situated as nearly under the apex of the hill as possible, and is surrounded on all sides, both above and below, by what Mr. Smeathman calls the *royal apartments*, which contain only labourers and soldiers, who can be intended for no other purpose than to continue in the nest either to guard or serve their common parents, on whose safety the happiness and probably the existence of the whole community depend. These apartments compose an intricate labyrinth, which extends a foot or more in diameter from the royal chamber on every side. Here the nurseries and magazines of provisions begin; and, being separated by small empty chambers and galleries, which surround them, and communicate with each other, are continued on all sides to the outward shell, and reach up within two thirds or three fourths of its height, leaving an open area in the middle under the dome, which resembles the nave of an old gothic cathedral. This area is surrounded by large gothic arches, which are sometimes two or three feet high next to the front of the area, but diminish rapidly as they recede, like the arches of aisles in perspectives, and are soon lost among the innumerable chambers and nurseries behind them. All these chambers and passages are arched, and contribute naturally to support one another. The inferior building, or assemblage of nurseries, chambers, and passages, has a flattish roof without any perforation. By this contrivance, if, by accident, water should penetrate the external dome, the apartments below are preserved from injury. The area has also a flattish floor, which is situated above the royal chamber. It is likewise water-proof, and so constructed, that, if water gets admittance, it runs off by subterraneous passages, which are cylindrical, and some of them so much as even thirteen inches in diameter. These subterraneous passages are thickly lined with the same kind of clay of which the hill is composed: they ascend the internal part of the external shell in a spiral form, and, winding round the whole building up to the top, intersect and communicate with each other at different heights. From every part of these large galleries a number of pipes, or smaller galleries, leading to different apartments of the building, proceed. There are likewise a great many which lead downward, by sloping descents, three and four feet perpendicular under ground, among the gravel, from which the labouring Ants select the finer parts; which, after being worked up in their mouths to the consistence of mortar, become that solid clay, or stone, of which their hills, and every apartment of their buildings except the nurseries, are composed. Other galleries ascend and lead out horizontally on every side, and are carried under ground, but near the surface, to great distances, for the purpose of foraging.

When a breach is made in one of the walls by an ax, or other instrument, the first object that attracts attention is the behaviour of the soldiers or fighting insects. Immediately after the blow is given, a soldier comes out, walks about the breach, and seems to examine the nature of the enemy, or the cause of the attack. He then goes into the hill, gives the alarm, and in a short time large bodies rush out as fast as the breach will permit. It is not easy to describe the fury that actuates these fighting insects. In their eagerness to repel the enemy they frequently tumble down the sides of the hill, but recover themselves very quickly, and bite every thing they encounter. This biting, joined to the striking of their forceps upon the building, makes a crackling or vibrating noise, which is somewhat shriller and quicker than the ticking of a watch, and may be heard at the distance of several feet. While the attack proceeds, they are in the most violent bustle and agitation. If they get hold of any part of a man's body, they instantly make a wound which gives some pain. When they attack the leg, the stain of blood upon the stocking extends more than an inch in width. They make their hooked jaws meet at the first stroke, and never quit their hold, but will suffer themselves to be pulled away piece after piece, without any attempt to escape. On the other hand, if a person keeps out of their reach, and gives them no farther disturbance, in less than half an hour they retire into the nest, as if they supposed the monster that damaged their castle had fled. Before the whole of the soldiers have got in, the labouring insects are all in motion, and hasten towards the breach, each of them having a quantity of tempered mortar in his mouth. This mortar they stick upon the breach as fast as they arrive, and perform the operation with so much dispatch and facility, that, notwithstanding the immensity of their numbers, they never stop or embarrass one another. During this scene of apparent hurry and confusion, the spectator is agreeably surprised when he perceives a regular wall gradually rising and filling up the chasm. While the labourers are thus employed, almost all the soldiers remain within, except here and there one, who saunters about among six hundred or a thousand labourers, but never touches the mortar. One soldier, however, always takes his station close to the wall that the labourers are building. This soldier turns himself leisurely on all sides, and, at intervals of a minute or two, raises his head, beats upon the building with his forceps, and makes the vibrating noise formerly mentioned. A loud hiss instantly issues from the inside of the dome and all the subterraneous caverns and passages. That this hiss proceeds from the labourers is apparent; for, at every signal of this kind, they work with redoubled quickness and alacrity. A renewal of the attack, however, instantly changes the scene. "On the first stroke," Mr. Smeathman remarks, "the labourers run into the many pipes and galleries with which the building is perforated, which they do so quickly that they seem to vanish; for in a few seconds all are gone, and the soldiers rush out as numerous and as vindictive as before. On finding no enemy they return again leisurely into the hill; and, very soon after, the labourers appear loaded as at first, as active, and as sedulous, with soldiers here and there among them, who act just in the same manner, one or other of them giving the signal to hasten the business. Thus the pleasure of seeing them come out to fight or to work, alternately, may be obtained as often as curiosity excites, or time permits; and it will certainly be found, that the one order never attempts to fight, nor the other to work, let the emergency be ever so great."

It is exceedingly difficult to explore the interior parts of a nest or hill. The apartments which surround the royal chamber and the nurseries, and indeed the whole fabric, have such a dependance on each other, that the breaking of one arch generally pulls down two or three. Another great obstacle is the obstinacy of the soldiers, who, says our author, "fight to the very last, disputing every inch of ground so well, as often to drive away the negroes who are without shoes, and make white people bleed plentifully through their stockings. Neither can we let a building stand so as to get a view of the interior parts without interruption; for, while the soldiers are defending the outworks, the labourers keep barricading all the way against us, stopping up the different galleries and passages which lead to the various apartments, particularly the royal chamber, all the entrances to which they fill up so artfully as not to let it be distinguishable while it remains moist; and, externally, it has no other appearance than that of a shapeless lump of clay. It is however easily found, from its situation with respect to the other parts of the building, and by the crowds of labourers and soldiers which surround it, who shew their loyalty and fidelity by dying under its walls. The royal chamber in a large nest is capacious enough to hold many hundreds of the attendants, besides the royal pair, and it is always found as full of them as it can hold. These faithful subjects never abandon their charge even in the last distress; for, whenever I took out the royal chamber, as I often did, and preserved it for some time in a large glass bowl, all the attendants continued running in one direction round the king and queen with the utmost solicitude, some of them stopping at the head of the latter, as if to give her something. When they came to the extremity of the abdomen, they took the eggs from her, carried them away, and piled them carefully together in some part of the chamber, or in the bowl under, or behind any broken pieces of clay which lay most conveniently for the purpose*."

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* Phil. Tran. vol. lxxi. p. 139—192.

THE LOUSE TRIBE.

The mouth in these animals is formed by a retractile recurved sucker, without a proboscis. There are no feelers, and the antennæ are about the length of the thorax. The abdomen is somewhat flattened; and the legs, which are six in number, are formed not for leaping, but running.

They live on animal juices, which they extract from living bodies by means of their sucker. The larva and pupa resemble the perfect insect.

THE COMMON LOUSE*.

When we examine the human Louse with the microscope, its external deformity strikes us with disgust. The fore part of its head is somewhat oblong, whilst the hind part is rounded. The skin is hard and transparent, with here and there a few bristly hairs. On each side of its head are two antennæ or horns, jointed, and covered with bristly hair; and behind the seare the eyes, which are large and black. The neck is short, and the breast divided into three parts; on each side of which are placed three legs, armed at the end with small claws, by which the animal lays hold of different objects. The trunk or proboscis is generally concealed in its tube: this is very sharp, and furnished towards its upper part with a few reversed prickles. By means of this the animal feeds; and when it is engaged in sucking any animal, the blood may be ſeen, through the transparency of its external covering, to rush like a torrent into the stomach. Through this its stomach and intestines are also visible, as well as the ramifications of the tracheæ or respiratory tubes, which appear dispersed in a most beautiful manner throughout various parts of the animal.

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* Pediculus humanus. *Linn.*

Scarcely any creature multiplies so quickly as this unwelcome intruder. It has been pleasantly said, that a Louse becomes a grandfather in the space of twenty-four hours. This fact cannot be ascertained; but nothing is more true than that the moment the nit, which is no other than the egg of the Louse, gets rid of its superfluous moisture, and throws off its shell, it begins to breed in its turn. Nothing so much prevents the increase of this nauseous animal, as cold and want of humidity. The nits, unless they are laid in a place that is warm, do not produce any thing: and from this it is that many of the nits laid on the hairs in the night-time are destroyed by the cold of the succeeding day.

In Mexico these animals were so numerous, that the antient kings found no other means of ridding their subjects of them, than by the imposition of an annual tribute of a certain quantity. Ferdinand Cortes found bags full of them in the palace of Montezuma.

" This is a creature (says Albin) so officious, that it will be known to every one at one time or other, so busy, and so impudent, that it will be intruding itself into every one's company; and withal so proud and aspiring, that it fears not to trample on the best, and affects nothing so much as a crown. It feeds and lives very high; and that makes it so saucy as to pull any one by the ears that comes in its way, and it will never be quiet till it has drawn blood. It is troubled at nothing so much as that a man scratches his head, as knowing that man is plotting and contriving some mischief against it: this makes it oftentimes skulk into some meaner and lower place, and run behind a man's back, though it go very much against the hair, which ill conditions it, having made it better known than trusted *,"

THE FLEAS.

The mouth in the Fleas is without either jaws or feelers, having only a long inflected proboscis concealing a single bristle. The antennæ are beaded; the abdomen is compressed sideways; and the legs are six, and formed for leaping.

THE COMMON FLEA †.

Notwithstanding the general disapprobation of this insect, it has certainly something very pleasing in its appearance. When examined with a microscope, it will be observed to have a small head, large

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[*] Albin's Spiders, p. 70.

[†] Pulex irritans. *Linn.*

eyes, and two short, four-jointed antennæ, between which is the trunk, or proboscis. The body appears enveloped in a shelly armour that is always clean and bright: this is beset at the segments with many sharp bristles. All its motions indicate agility and elegance; and its muscular power is so extraordinary as justly to excite our wonder. We know no other animal whatever whose muscular strength can be put in competition with that of a Flea; for, on a moderate computation, it is known to leap to a distance of at least two hundred times its own length.

There is no kind of proportion between the force and size of all the insect tribe. Had man an equal degree of strength, bulk for bulk, with a louse or flea, the history of Samson would be no longer miraculous. A Flea will drag after it a chain a hundred times heavier than itself; and, to compensate for this force, will eat ten times its own weight of provisions in a single day. Mr. Boverich, an ingenious watchmaker who some years ago lived in the Strand, London, exhibited to the public a little ivory chaise, with four wheels and all its proper apparatus, and a man sitting on the box, all of which were drawn by a single Flea. He made a small landau, which opened and shut by springs, with six horses harnessed to it, a coachman sitting on the box, and a dog between his legs; four persons in the carriage, two footmen behind it, and a postillion riding on one of the fore-horses, which was also easily drawn along by a Flea. He likewise had a chain of brass, about two inches long, containing two hundred links, with a hook at one end, and a padlock and key at the other, which the Flea drew very nimbly along.

This little animal is produced from eggs which the females stick fast, by a kind of glutinous matter, to the roots of the hairs of cats, dogs, and other animals; or to the wool in blankets, rugs, or other similar furniture. Of these eggs the female lays ten or twelve a day, for several days successively, and they are hatched in the same order five or six days after being laid.

From the eggs come forth not perfect fleas, but little, whitish worms, or maggots, whose bodies have annular divisions, and are thinly covered with long hairs. They adhere closely to the body of the animal, &c. on which they were produced, and feed on the scurfy excretion of the skin, the downy substance of linen, &c. They are about a fourth of an inch in length, and without feet; but they are, notwithstanding, very lively and active. When alarmed they suddenly roll themselves up into the shape of a little ball. They may be kept in a box, and brought up with dead flies, which they eat with greediness. They are very nimble, and crawl like caterpillars, with a lively and brisk motion.

In eleven days from their being hatched, they leave off eating, and lie as though they were dying; but if viewed in this state with a microscope they will be found weaving a silken covering around them, in which they are to change into their chrysalis form. They continue nine days in this shape, at first white, and afterwards by degrees darkening their colour as they acquire firmness and strength. As soon as they issue from their bag they become perfect fleas, and are able to leap away.

THE CHIGOE*.

Ulloa has given us a good account of a troublesome insect that is too well known in some parts of America. This is called in Surinam Chigoe, in Mexico, Nigua, and Pique in Peru. It is, he says, so small as to be almost imperceptible. The legs of these insects have not the elasticity of those of fleas; for, if they had as great powers of leaping as the fleas, there is not a living creature that would not be full of them; and this lurking race would destroy three fourths of mankind by the evils they would produce. They are always found amongst the dust, and particularly in filthy places; they fix themselves on the legs, to the soles of the feet, and even to the fingers.

This creature pierces the skin so subtilely that at the time the person is not sensible of it; nor is it to be perceived till it begins to extend itself. At first it is not difficult to extract it; but, although it may only have introduced its head, it makes so firm a lodgment, that a part of the skin must be sacrificed before it will quit its hold. If it is not soon perceived, the insect completes its lodgment, sucks the blood, and forms a nest of a white thin tunicle, in the shape of a flat pearl. It extends itself in this space in such a manner, that its head and feet are towards the exterior side, for the convenience of nourishment; and the other part of the body anſwers to the inner side

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[*] Pulex penetrans. *Linn.*

of the tunicle, in order to lay its eggs there. In proportion as these are laid, the little pearl is enlarged; and in four or five days it is at least two lines in diameter. It is then of the utmost consequence to have it extracted; for if this is neglected it bursts of itself, and spreads an infinity of nits, which, when hatched, fill the whole part, and produce excessive anguish; and the difficulty of dislodging them becomes very great. These penetrate to the very bones; and even when the sufferer has got rid of them, the pain will last till the flesh and skin are entirely healed.

The operation of extracting them is long and painful. It consists in separating, with the point of a needle, the flesh next to the membrane where the eggs are lodged ; which is not easily done without bursting the tunicle. After having separated even the most minute ligaments, the nest is to be extracted. If unfortunately it burst, particular care must be taken to extract every root of it, and especially not to leave behind the principal insect. This would begin to lay its eggs again before the wound could be healed ; and, penetrating much farther into the flesh, would increase the difficulty of extracting it. During the great heats extreme care must be taken not to wet the part affected. Without this precaution, experience has proved that the patient is subject to consequences that frequently prove fatal.

" The Chigoe," says Stedman, in his account of the expedition to Surinam, " is a kind of small sand-flea, common in Surinam, which gets in between the skin and the flesh without its being felt, and generally under the nails of the toes; where, while it feeds, it keeps growing till it becomes of the size of a large pea, causing no further pain than a disagreeable itching. In process of time it appears in the form of a small bladder, in which are deposited thousands of eggs or nits, and which, if it breaks, produce so many young Chigoes, that in course of time create running ulcers, which are often of very dangerous consequence to the patient: so much so, indeed, that I knew a soldier, the soles of whose feet were obliged to be cut away before he could recover; and ſome men have lost their limbs by amputation—nay even their lives, by having neglected in time to root out these abominable vermin. The moment therefore that a redness and itching, more than usual, is perceived, it is time to extract the Chigoe that occasions it. This is done with a sharp-pointed needle, at which the black girls are extremely dexterous, taking care not to occasion unnecessary pain, and to prevent the chigoe or bladder from breaking in the wound. Tobacco ashes are put in the orifice, by which, in a little time, the sore is perfectly healed."

THE TICKS.

These troublesome insects live chiefly on other animals; some of them however inhabit the water, and others subsist on various vegetable substances.

Their mouth is without any proboscis, but the sucker has a two-valved cylindrical sheath. They have two compressed feelers as long as the sucker; two eyes, one on each side of the head, and eight legs.

THE CHEESE-MITE *.

To the naked eye these minute animals appear little more than moving particles of dust; but on the application of the microscope they are found to be perfect animals, performing all the regular functions. The head is small in proportion to the rest of the body. Their legs are furnished at the extremities with little claws, by which they are enabled to lay firm hold of the substances they inhabit. The body is furnished with long hairs, which they have the power of laying close; and by this means they are enabled to creep through very narrow crevices.

The females, which are easily distinguished from the males, are oviparous. The eggs are hatched in warm weather in about twelve days, but during the winter season the time of hatching is much longer. When the young ones first come forth they are extremely minute, and before they attain their full size they cast their skin several times.

The mites are very quick-sighted; and when once they have been touched with a pin, it is easy to perceive a great degree of cunning exerted to avoid a second touch. They are extremely voracious animals, and are often observed even to devour each other:

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* Acarus Siro. *Linn.*

and so very tenacious are they of life that they have been kept alive many months between two concave glasses, by which they were applied to a microscope. Leeuwenhoek placed a female mite on the point of a pin for examination: she remained there ten days, and during the time laid two eggs, which from want of other food she devoured.

THE HARVEST-BUG*.

The Harvest-bug is of a somewhat globular shape, and of a bright red colour, with the abdomen bristly behind. It is smaller than the common mite, and by its colour but just to be perceived when on the skin. In the months of August and September it is very troublesome, adhering to the skin by means of two short arms situated above the upper legs, so firmly as not easily to be disengaged. Wherever it fixes it causes a tumor about the size of a pea, or larger, accompanied by a most unpleasant itching. Its tubular snout, by which it takes its food, is generally concealed.

These insects abound in vegetables, and are generally caught from walking in gardens, among long grass, or in corn-fields.

Mr. White says they abound so greatly on the chalky downs of Hampshire, that the warreners' nets are frequently discoloured from the immense numbers that get upon them; whilst the men are sometimes so bitten as to be thrown into fevers†.

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* Acarus autumnalis. Autumnal Acarus, or Harvest-Bug. *Shaw's Nat. Mis.*

† Shaw's Nat. Mis. ii. tab. 42.—White's Selborne.

THE SPIDERS.

SPIDERS have short horny jaws, and two incurved, jointed, and very sharp feelers. They are without antennæ; and have eight or sometimes only six eyes, and eight legs. Their abdomen is hairy, and furnished with papillæ from which they spin their webs.

THE HOUSE-SPIDER*.

This species is very common in houses, and particularly about windows. The abdomen is nearly oval, of a brown colour, and marked with five almost contiguous spots.

They feed principally on flies; and the web by which they are enabled to entangle these insects is a surprising part of the animal economy. For the purpose of forming this web, they are supplied with a quantity of glutinous matter contained in a receptacle near the extremity of their bodies; and they have five teats for spinning it into thread, the orifices of which the insects have the power of contracting and dilating at pleasure. When they enter on this curious fabric, they fix on a spot of apparent plunder and security. The animal then distils one little drop of glutinous liquor, which is very tenacious; and creeping along the wall, and joining its thread as it proceeds, darts itself to the opposite side, where the other end is to be fastened. The first thread thus formed, being drawn tight and fixed at each end, the Spider runs on it backwards and forwards, still doubling and strengthening it, as on this depends the stability of the whole. The scaffolding thus completed, it makes a number of threads parallel to the first, and then crosses them with others, the clammy substance of which they are formed serving, when first made, to bind them to each other. At the bottom of the web is a funnel, in which the little creature is concealed. In this den of destruction it watches with unremitted assiduity till its prey is entangled, on which it instantly darts with inevitable ruin.

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* Aranea domestica. *Linn.*

The web of the Spider differs from those woven by any human artist in this circumstance, that in our work, the threads extended in length are interlaced with those that are carried on transversely; whereas the threads of a Spider's woof only cross the threads of the warp, and are glued to them in the points where they mutually touch, and are not either inserted or interwoven.

The threads along the border of the work are doubled or trebled by the Spider's opening all her teats at once, and glueing several threads one over another; sensible that the extremity of the web ought to be hemmed and fortified to preserve it from being torn: she likewise further secures and supports it with strong loops, or double threads, which she fixes all around it, and which hinder it from being the sport of the winds.

From time to time she finds it necessary to clear away the dust, which would otherwise incommode her web, and she sweeps the whole by giving it a shake with her paw; but in doing this she so nicely proportions the force of the blow to the strength of the work that nothing is ever broken.

From all parts of the web are drawn several threads, which terminate like rays in a centre at the place of her concealment. The vibration of any of these threads is communicated to her, and gives her notice that game is in the net, and accordingly she springs upon it in an instant. She derives another advantage from this retreat under her web, and that is the opportunity it affords of feasting on her prey in full security; and besides this it gives her the power of concealing the carcasses, and not leaving in the purlieus any traces of her barbarity capable of intimating the place of her resort, and inspiring other insects with the dread of approaching it.

> But chief to the heedless flies the window proves
> A constant death; where, gloomily retir'd,
> The villain Spider lives: cunning, and fierce,
> Mixture abhorr'd! Amid a mangled heap
> Of carcasses, in eager watch he sits,
> O'erlooking all his waving snares around.
> Near the dire cell the heedless wanderer oft
> Passes, as oft the ruffian shows his front.
> The prey at last ensnar'd, he dreadful darts
> With rapid glide along the leaning line:
> And, fixing in the wretch his cruel fangs,
> Strikes backward, grimly pleas'd: the fluttering wing
> And shriller sound declare extreme distress,
> And ask the helping hospitable hand.

This Spider is furnished with a pair of very sharp hooked fangs, inclosed, when at rest, in cases in the fore part of his head. With this weapon (which a good glass will discover to have a small slit or orifice in each point) he seizes and pierces such insects as entangle themselves in his web ; and, by infusing a poisonous juice into the wound, in a moment kills them. This poison must be very active and deleterious ; for flies, and many other insects, may be mutilated by depriving them of their legs, wings, and even cutting their bodies through the very middle of the abdomen, and in that condition will survive several days.

When two spiders of the same size meet in combat, neither of them will yield : they hold each other by their fangs so fast, that one of the two must die before they are separated.—M. Leeuwenhoek says, he saw one spider that was however only wounded in the leg by his antagonist. A drop of blood as large as a grain of sand issued from the sore : and not being able to use this wounded leg in running away from his enemy, he held it up, and presently afterwards the whole limb dropped from his body. When they are wounded in the breast or upper parts of their body these insects always die*.

The spider, the dermestes, and many insects of the beetle kind, exhibit an instinct of an uncommon nature. When put in terror by a touch of the finger, the spider runs off with great swiftness : but if he finds that, whatever direction he takes, he is opposed by another finger, he then seems to despair of being able to escape, contracts his limbs and body,. lies perfectly motionless, and counterfeits every symptom of death. "In this situation," says Mr. Smellie, "I have pierced spiders with pins, and torn them to pieces, without their discovering the smallest marks of pain. This simulation of death has been ascribed to a strong convulsion, or stupor, occasioned by terror. But this solution of the phenomenon is erroneous. I have repeatedly tried the experiment, and uniformly found, that, if the object of terror be removed, in a few seconds the animal runs off with great rapidity. Some beetles, when counterfeiting death, will suffer themselves to be gradually roasted without moving a single joint*."

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* Phil. Tran. vol. xxii. p. 870.

When this animal changes its skin, which it does at certain seasons, an opening may be seen, if carefully watched, in the belly: through this it draws all its limbs, and leaves the old covering hanging to the cord that sustained it during the operation.

The eyes of all the spiders are placed on the upper part of the head, but in various positions. They have no muscles belonging to them, and they are therefore altogether immoveable: they also consist only of one lens each, and do not as in other insects possess the faculty of multiplying objects; but their number and situation enable the animals to see perfectly well in all necessary directions.

THE GARDEN-SPIDER.

The labour of the Garden Spider is very different from that of the former species, yet it is not performed with less art. When desirous of flitting from one place to another, this animal fixes one end of a thread to the place where she stands, and then with her hind paws draws out several other threads from the nipples; which, being lengthened out, and driven by the wind to some neighbouring tree or other object, is by its natural clamminess fixed to it. When she finds that this is fastened, she makes of it a bridge on which she can pass or repass at pleasure. This done, she renders the thread still thicker by spinning others to it. From this thread she often descends by spinning downwards to the ground: the thread formed by the latter operation she fixes to some stone, plant, or other substance. She reascends to the first thread, and at a little distance from the second begins a third, which she fixes in the same manner. She now strengthens all the three threads, and then beginning at one of the corners weaves across, and at last forms a strong and durable net, in the centre of which she places herself with her head downwards to wait for her prey.

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* Smellie's Philosophy of Natural History.

From having frequently remarked that spiders spread their webs in solitary and confined places, to which it is sometimes difficult for flies to penetrate; M. Le Vaillant naturally concluded that these creatures must frequently remain long without food, and that consequently they were capable of enduring considerable abstinence.

To ascertain the truth of this circumstance, he took a large Garden Spider, whose belly was about the size of a nut, and inclosed it under a glass bell, which he secured with cement round its bottom, and left it in this situation for ten months. Notwithstanding this deprivation of food, it appeared during the whole time equally vigorous and alert; but its belly insensibly decreased, till at last it was scarcely larger than the head of a pin.

He then put under the bell to it another spider of the same species. For a little while they kept at a respectful distance from each other, and remained motionless; but presently the meagre one, pressed by hunger, approached and attacked the stranger. It returned several times to the charge; and in these different conflicts its enemy became deprived of almost all its claws; it carried these away, and retired to its former situation to devour them. The meagre one had likewise lost three of its own claws, on which also it fed; and M. Le Vaillant perceived that by this repast its plumpness was in some measure restored. The day following, the new comer, deprived of all its means of defence, fell a complete sacrifice. It was speedily devoured; and in less than twenty-four hours the old inhabitant of the bell became as plump as it was at the first moment of its confinement *.

From the bags in which the young of the Garden Spider is produced, an attempt has been made to manufacture a kind of silk, which has in some degree proved successful. With some trouble thirteen ounces of these bags were collected. They were beaten for some time with a stick to free them

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* Le Vaillant's New Travels, Introd. p. xxxix.

from dust, and then washed in warm water till they were perfectly clean. After this they were steeped for some time in a pot with soap, nitre, and gum arabic, and then boiled in the same mixture over a gentle fire for two or three hours. Clean warm water was again used to free them from the soap, &c.; and after being laid for some days to dry, they were loosened with the fingers previously to being carded by the common silk-carders. A beautiful ash-coloured silk was thus obtained, easy to be spun, and much stronger in the thread than that of the silkworm. This was weaved in the stocking-weaver's loom, and there can be no doubt but it would bear any other loom. The thirteen ounces of bags yielded near four ounces of silk, three of which made a pair of stockings large enough for a man.—It would be a difficult task to obtain bags sufficient to render the manufacture of the silk of any importance, since to obtain one pound of silk no fewer than 28,000 bags would be wanted; and for this quantity a greater number of spiders than this must be bred, as none but the females spin them. But a still greater difficulty arises from their carnivorous disposition in devouring each other. Had this not been the case, a very nutritious food might have been adopted for them in the soft substance of fresh quills. If the silk had answered, we should have had from the different species of spiders several genuine colours in silk; such as grey, white, sky-blue, and coffee colour: whereas silkworms yield only white and orange colour.

The females lay six or seven hundred eggs in the same bag. This is generally done in August or September, and about sixteen days afterwards the young are hatched. If the weather continues cold, the young remain in their nidus for several months without eating or increasing in bulk; but make their appearance abroad on the commencement of the warm weather. The old ones live but a short time after the eggs are laid*.

THE WANDERING SPIDER†.

This spider does not lie in wait for its prey, like several others; it is a lively, active hunter. Its head is furnished, as in the rest, with immoveable eyes. Without any motion of the head it perceives all the flies that hover around; it does not alarm, but stretches over them its arms, furnished with feathers, which prove nets that entangle their wings. The spider seizes them with its merciless claws, and sucks their blood.

THE JUMPING SPIDER‡.

The manners of the Jumping Spider are very singular. It does not, like many others, take its prey by means of a net, but is constrained to seize them only by its own activity. It is extremely nimble, at times leaping like a grashopper, then standing still, and raising itself on its hind legs to look around for its prey. If it sees a fly at the distance of three or four yards, it does not run directly to it, but endeavours, as much as possible, to conceal itself till it can arrive near; and then creeping slowly up, and but seldom missing its aim, it springs upon the insect's back, and it is then almost impossible for the fly to effect an escape. But if, before the spider gets to it, the fly takes wing, and fixes upon another place, it whirls nimbly about, and still keeps its eyes upon it, in order to commence a fresh attack. Dr. Brookes says that it has been sometimes seen in the act of instructing its young ones how to hunt; and also, that whenever an old one missed its leap, it would run from the place, and hide itself in some crevice, as if ashamed of its mismanagement.

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* Phil. Tran. vol. xxvii. p. 2. † Aranea viatica. *Linn.*
‡ Aranea scenica. *Linn.*

THE WATER-SPIDER *.

This singular little creature is a very common inhabitant of our fresh waters. When in the water its belly appears as if covered with a silver varnish: this is, however, nothing more than a bubble of air attached to the abdomen by the oily humours which transpire from the body, and prevent the immediate contact of the water. By means of this kind of bubble this insect forms its dwelling under the water. It fixes several silky threads to the stalks of the water plants, and then, ascending to the surface, thrusts the hinder part of its body above the water, drawing it back with so much rapidity as to attach beneath a bubble of air, which it has the art of detaining below by

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* Aranea aquatica. *Linn.*

placing it under the threads above mentioned, and which it bends, like a covering, almost round it. It then again ascends for another air bubble, and thus proceeds till it has constructed a large aërial apartment under the water, which it enters into or quits at pleasure. The male constructs for himself one near that of the female, and afterwards breaks through the thread walls of the female's dwelling; and the two bubbles, attached to the bellies of both, unite into one, forming one large chamber.

The female takes care of the young, and constructs similar apartments for them.

The figure of this spider has in it nothing remarkable, and will be overlooked among a crowd of curiosities, if the spectator be unacquainted with its singular art of constructing an aërial habitation under water, and thus availing itself of the properties of both elements. It lodges, during the winter, in empty shells, which it dexterously shuts up with a web.

THE GOSSAMER SPIDER*.

The following observations on the origin of the Gossamer, by M. Bechstein, a German naturalist, are curious, and convey a more accurate account of it than we have been able to meet with in any other writer.

"Some naturalists (says this gentleman) have considered this phenomenon as the evaporation of plants condensed during the cool days of harvest by the air, and converted into threads like those which can be drawn from resinous juices; others, as the production of a kind of spider, on account of its similarity to the threads of common spiders: and M. Pereboom has discovered a kind of beetle, furnished with a vesicle on its back, from the hinder parts of which, on both sides, proceed two threads that extend over the extremity of the body, and end in a double thread sometimes ten or more inches in length, which thread he supposes to form the Gossamer.

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* Aranea Obtextrix ?

" Having made for many years the closest observations on this phenomenon, I am of opinion that it is caused by a species of field spider, so small and active as to be imperceptible, unless the observer possesses a very acute sight. This spider, if it has no name already, I propoſe to call the Gossamer Spider, *Aranea Obtextrix*. It is about the size of the head of a small pin. Its head is somewhat long, and has in the fore-part eight grey eyes, placed in a circular form. The body is of a shining dark brown colour, with the abdomen shaped like an egg.. The legs are moderately yellowish.

" These spiders first appear in the beginning of October, in woods, gardens, and meadows, where their eggs are hatched in safety: thence they spread themselves over whole districts, and during the rest of October, and till the middle of November, may be found in dry fields throughout Europe. Extensive tracts of land are sometimes seen swarming with them. In the beginning of October, when but very few are hatched, a few single threads of their webs, extending from twig to twig, are seen only in the sunshine; about the middle of the month their threads are more perceptible; and towards the end, if a person stands in such a position as to see the sunbeams play on the slender threads, hedges, meadows, corn-fields, stubble land, and even whole districts, appear covered as with a sort of fine white gauze.

" The Gossamer Spider does not weave a web, but only extends its threads from one place to another. These are so delicate, that a single thread cannot be seen unless the sun shines on it. One of them, to be visible at other times, must be composed of at least six common threads twisted together. In serene calm days these spiders work with great diligence, especially after the disappearance of the morning fogs. Between twelve and two, however, their industry excites the greatest admiration. A person with a pretty quick eye, or by the help of a glass, may sometimes perceive among the barley-stubble such a multitude of these insects extending their threads, that the fields appear as if covered with swarms of gnats.

" Several of the single threads become twisted together by the gentlest breath of wind, and form perceptible threads, which, being broken by stronger winds, unite into thick threads, or even into balls, and float through the atmosphere. These are then called, in Germany, the *flying summer*, because the summer seems to fly away at the same time. The spiders are conveyed in them: but it is not uncommon to find spiders of other species in them, which have been entangled and dragged away; and even the webs of other spiders, and the dried husks of insects that have been caught in them, are often found in the Gossamer.

" The Gossamer Spiders appear in swarms only during the harvest, but single spiders are to be found the whole summer through."

We have a very curious account of the Gossamer inserted by Mr. White in the Natural History of Selborne. " On September the 21st, 1741, being then on a visit, and intent on field-diversions, I rose before day-break. When I came into the inclosures, I found the stubbles and clover-grounds matted all over with a thick coat of cobweb, in the meshes of which a copious and heavy dew hung so plentifully that the whole face of the country seemed, as it were, covered with two or three setting-nets drawn one over another. When the dogs attempted to hunt, their eyes were so blinded and hoodwinked that they could not proceed, but were obliged to lie down and scrape the incumbrances from their faces with their fore feet; so that, finding my sport interrupted, I returned home, musing in my mind on the oddness of the occurrence.

" As the morning advanced the sun became bright and warm, and the day turned out one of those most lovely ones, which no season but the autumn produces; cloudless, calm, serene, and worthy of the south of France itself.

" About nine an appearance very unusual began to demand our attention; a shower of cobwebs falling from very elevated regions, and continuing, without any interruption, till the close of the day. These webs were not single filmy threads, floating in the air in all directions, but perfect flakes or rags, some near an inch broad, and five or six long, which fell with a degree of velocity that showed they were considerably heavier than the atmosphere.

" On every side as the observer turned his eyes he might behold a continual succession of fresh flakes falling into his sight, and twinkling like stars, as they turned their sides towards the sun.

" How far this wonderful shower extended would be difficult to say; but we know that it reached *Bradley*, *Selborne*, and *Alresford*, three places which lie in a sort of triangle, the shortest of whose sides is about eight miles in extent.

" At the second of those places there was a gentleman (for whose veracity and intelligent turn of mind I have the greatest veneration) who observed it the moment he got abroad; but concluded that as soon as he came upon the hill above his house, where he took his morning rides, he should be higher than this meteor, which, he imagined, might have been blown, like *thistle-down*, from the common above. But, to his great astonishment, when he rode to the most elevated part of the down, 300 feet above the level of his fields, he found the webs, in appearance, as much above him as before; still descending into sight in a constant succession, and twinkling in the sun, so as to draw the attention of the most incurious.

" Neither before nor after this was any such fall observed; but on this day the flakes hung in the trees and hedges so thick, that a diligent person sent out might have gathered baskets full.

" The remark that I shall make on these cobweb-like appearances, called *gossamer*, is, that, strange and superstitious as the notions about them were formerly, nobody in these days doubts but that they are the real production of small spiders which swarm in the fields in fine weather in autumn, and have a power of shooting out webs from their tails so as to render themselves buoyant, and lighter than air. But why these apterous insects should *that day* take such a wonderful aërial excursion, and why their webs should at once become so gross and material as to be considerably more weighty than air, and to descend with precipitation, is a matter beyond my skill. If I might be allowed to hazard a supposition, I should imagine that those filmy threads, when first shot, might be entangled in the rising dew, and so drawn up, spiders and all, by a brisk evaporation, into the regions where clouds are formed: and if the spiders have a power of coiling and thickening their webs in the air, as Dr. Lister says they have*, then, when they become heavier than the air, they must fall.

" Every day in fine weather, in autumn chiefly, do I see these spiders shooting out their webs and mounting aloft: they will go off from your finger' if you take them into your hand. Last summer one alighted on my book as I was reading in the parlour; and running to the top of a page, and shooting out a web, took its departure from thence. But what I most wondered at was, that it went off with considerable velocity in a place where no air was stirring; and I am sure I did not assist it with my breath. So that these little crawlers seem to have, while mounting, some locomotive power without the use of wings, and to move in the air faster than the air itself."

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* Letters to Mr. Ray.

THE TARANTULA*.

The Tarantula is somewhat more than an inch in length, and has its breast and belly of an ash-colour: its legs are likewise ash-coloured, with blackish rings on the under part: its fangs are red within. It is a native of Italy, Cyprus, Barbary, and the East Indies. It lives in fields, and its dwelling is about four inches deep, half an inch wide, and closed at the mouth with a net. At the bottom this is curved; and there the insect sits in wet weather, and from thence cuts its way out if water gains upon it. These spiders do not live quite a year. They lay about 730 eggs, which are hatched in the spring. The parents never survive the winter.

Inflammation, difficulty of breathing, and sickness, are said to be the invariable consequents to the bite of this creature. Dr. Mead and other medical men have countenanced the ridiculous story of these effects being counteracted by the power of music. It is, however, now well known, that this singular mode of cure was nothing more than a trick frequently practised on credulous travellers, who were desirous of witnessing it. Mr. Swinburne, when he was in Italy, minutely investigated every particular relative to this insect. The season was not far enough advanced, and it was pretended that no persons had that year been yet bitten: he, however, prevailed upon a woman, who had formerly been bitten, to dance the part before him. Several musicians were summoned, and she performed the dance, as every one present assured him, to perfection. At first she lolled stupidly on a chair, while the instruments played a dull strain. They touched at length the chord supposed to vibrate to her heart; and up she sprang with a most hideous yell, staggered about the room like a drunken person, holding a handkerchief in both hands, raising them alternately, and moving in very true time. As the music grew brisker, her motions quickened, and she skipped about with great vigour, and in a variety of steps, every now and then shrieking very loud. The scene was unpleasant, and at his request an end was put to it before the woman was tired.

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* Aranea Tarantula. *Linn.*

He informs us that, wherever they are to dance, a place is prepared for them hung round with bunches of grapes and ribbons. The patients are dressed in white, with red, green, or yellow ribbons; on their shoulders they have a white scarf; they let their hair fall loose about their ears, and throw their head quite back. He says that they are exact copies of the ancient priestesses of Bacchus. The introduction of Christianity abolished all public exhibitions of heathenish rites. But the women, unwilling to give up their darling amusement in performing the frantic part of Bacchantes, devised other pretences; and he supposes that accident led them to the discovery of the Tarantula, on the strength of whose poison the Puglian dames still enjoy their old dance, though time has effaced the memory of its ancient name and institution.

If these dancers are at any time really and involuntarily affected, Mr. Swinburne supposes that it can be from no more than some attack upon the nerves, a kind of St. Vitus's dance [*].

THE BIRD-CATCHING SPIDER [†].

If the spiders that are found in Europe are looked upon with aversion and alarm by those who are in the habits of constantly seeing them, surely this American species, whose gigantic size and great muscular power render it a terror even to the feathered tribes, cannot be beholden without the most violent sensations of horror.

This enormous creature will extend with its feet a space of near ten inches. From the head to the extremity of the abdomen it often measures above three inches. The legs are as thick as a goose's quill, and closely covered with hair. The body is brown, and the fangs are as strong and sharp as in some of the rapacious species of birds. It is not uncommon in many parts of America, but is principally found in the southern division of that continent, and particularly in Guiana.

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[*] Swinburne's Travels, i. 391—395.

[†] Aranea avicularia. *Linn.*

Captain Stedman, while residing in Surinam, had one of them given to him, which he put into a case-bottle above eight inches high, and when this was filled with spirits it reached the surface with some of his claws, while others rested on the bottom. On the whole, he says, this spider is so hideous a creature, that the very sight of it is sufficient to occasion a tremor of abhorrence, even in persons most accustomed to inspect the deformities of nature*.

It resides in the trees, and frequently seizes on small birds, which it destroys by sucking their blood, after having first wounded them by its fangs, which distil a poisonous liquid into the wound. The slit or orifice near the tip of the fangs, through which this poison is emitted, is, in the present species, so visible as to be distinctly perceived without a glass †.

The eight eyes of this terrible insect are placed somewhat in the form of an oblong square in the front of the thorax. Of these the two middle ones are so large as to be capable of being set in the manner of glasses, and used as microscopes: the rest are smaller and of an oval shape. The thorax is orbicular, and has a transverse central excavation.

In Jamaica there is a species of Spider ‡, the female of which digs a hole in the earth obliquely downwards, about three inches in length, and one inch in diameter; this cavity she lines with a tough thick web, which, when taken out, resembles a leathern purse: but, what is most curious, this house has a door with hinges, like the operculum of some sea shells; and herself and family, who tenant this nest, open and shut the door whenever they pass or repass *.

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* Stedman's Surinam. † Shaw's Nat. Mis. i. tab. 12.

‡ Aranea nidulans, Gmel. Syst. Nat. Linn.

In some places in the forest of Java the webs of Spiders have been found, woven with threads of so strong a texture as not easily to be divided without a knife †.

Dampier informs us, that at Campeachy in New Spain there "is a sort of Spiders of a prodigious size, some nearly as big as a man's fift, with long small legs, like the Spiders in England. They have two fangs, each an inch and a half long, and of a proportionable thickness, which are black as jet, smooth as glass, and, at their small end, as sharp as a thorn; these are not straight, but bending. Some persons wear them in their tobacco pouches to pick their pipes with; others preserve them for tooth-picks, especially such as are troubled with the tooth-ach; for, if report may be trusted, they will expel that pain. The backs of these Spiders are covered with a dark yellowish down as soft as velvet. Some say they are venomous, and others that they are not; but of which these are true I cannot determine."

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* Darwin's Zoonomia. † Staunton.

THE SCORPION TRIBE.

The Scorpions have eight legs, besides two claws, that serve the purpose of hands, situated on the fore-part of the head. They have also eight eyes, three of which are placed on each side of the thorax, and two in the middle. On the anterior part of the head are two short, claw-like feelers; but no antennæ: and on the under side, between the breast and the abdomen, are two instruments that have somewhat the resemblance of a comb. The tail is long, jointed, and terminated by a sharp crooked sting, from whence is emitted a pungent liquid, not dangerous, except in the very hot climates. Scorpions may, however, be considered as the most malignant and poisonous of all known insects. The poison is emitted through three very small foramina near the top of the sting, one on each side of the tip, and the other on the upper part.

They prey on worms and insects, and frequently even on one another. The young are produced from eggs, of which one female lays a considerable number; and after their appearance these seem to undergo no further change than perhaps casting their skin from time to time, in the same manner as the Spiders.

THE COMMON SCORPION*.

Most of the Scorpions have a distant resemblance

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* Scorpio Afer. *Linn.*

in shape to the lobster, but they are infinitely more ugly. The head, appears, as it were, jointed to the breast; and the mouth is furnished with two jaws, the under one of which is divided into two, and the parts, notched into each other, answer the purpose of teeth, in breaking the food. On each side of the head is a four-jointed arm terminated by a claw somewhat like that of a lobster. The belly is divided into seven segments, from the lowest of which the tail commences: this in the present species is armed with a hard, pointed, and crooked sting, the poison of which is very powerful.—They are most common about old houses, and in dry or decayed walls.

In some parts of Italy and France these Scorpions are among the greatest pests that can plague mankind; but in those countries of the East where they grow to a foot in length, there is no removing a piece of furniture without danger of being stung by them. There, we are told, they are full as bulky as a small lobster.

Many experiments have been made at different times to ascertain the strength of the poison, and in the warm climates it has uniformly been found fatal to the smaller animals. To man the wound is extremely painful. The place becomes inflamed, and the surrounding parts often turn livid, and require to be carefully dressed to prevent mortification. A story is related in the Ephemerides Curiosæ, that a person of the name of Wolkamer being desirous of trying the courage of the Scorpion against that of the large spider, he inclosed several of both kinds in glass vessels for that purpose. The success of one of these combats was very remarkable. The spider at first used all its efforts to immesh the Scorpion in its web, which it immediately began spinning; but the Scorpion soon rescued itself from danger, by stinging its adversary to death: it soon after cut off with its claws all the legs of the spider, and then at its leisure sucked the internal parts. Wolkamer was of opinion, that if the Scorpion's skin had been a little less hard, the spider would have obtained the victory, for he tells us that he had often himself seen one of these spiders destroy a toad * !

We are informed that when a Scorpion is surrounded by burning coals or wood, so as not to be able to escape their effects, it will strike its sting into its own body and destroy itself: but this seems to be merely a legend undeserving of belief.

M. Navarette says, that when he was in the Philippine islands he was instructed in an infallible preservative against the sting of the Scorpions: the reader will smile when he is told that this was nothing more than, when he went to bed, simply to make a commemoration of St. George. "I continued," says he, "this devotion many years; and, God be praised, the saint always delivered me, both there and in other countries, from those and such like insects." He says, however, afterwards, that he used another preventative, in rubbing all round his bed with garlic to keep them at a distance. The same credulity that dictated to him the commemo-

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* Ephemerides, Dec. 1687. Observ. 224.

ration of St. George, taught him, that the *moisture from a hen's mouth* was an excellent remedy *.

This creature, which is but too common in all hot countries, is extremely bold and watchful. Whenever any thing approaches, it seldom exhibits signs of fear, but with its tail erect, and sting in readiness, as fully confident of the force of its poison, it waits an attack with courage and intrepidity, and seldom desists till either it is killed or its enemy is put to flight.

THE CRAB TRIBE.

Most of the animals of the present tribe have eight legs, (a few have, however, six or ten,) besides two chelate ones that serve the purpose of hands, They have all six unequal feelers ; four antennæ, and two eyes projecting from the head, and moveable, being generally placed on peduncles or stalks. Their mandles are thick and horny, and the tail is articulated, and not (as in the Scorpion) armed.

Crabs are chiefly found in the water, where they feed on insects, worms, dead bodies, or vegetable substances. They change their shells annually; and when their skins are soft, which is always the case for some time after their casting the shell, they are frequently devoured both by the stronger animals of their own species, and by many others.

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* Navarette's Voyage to China, in Churchill's Coll. i. 235.

In the Lobster or Cray-fish division, the tail is formed of six convex, imbricated segments terminated by five laminæ. The former are narrower beneath than above, and united by loose membranes which admit of much motion. At the angle where the inferior joins the dorsal portion, these segments are furnished with a kind of crustaceous fins bordered with hair, and consisting of several articulations, called by naturalists *Pedes natatorii*. The fins are moved backward and forward, and a little outward and inward, by means of small muscles contained within each articulation, which do not differ very greatly from those of the real feet: by means of these the animals have their progressive motion at different depths in the water.

THE LAND CRAB*.

The Land Crabs are natives of the Bahamas, and of most of the other islands between the Tropics. They live in the clefts of rocks, the hollows of trees, or in holes which they dig for themselves in the mountains. About the months of April and May, they annually, in a body of some millions at a time, descend to the sea-coast in order to deposit their spawn, and at this season the whole ground seems alive with them. They march in a direct line to their place of destination, and are said seldom to turn out of their way on account of intervening obstacles: even if they meet with a lofty wall or a house, they will attempt to scale it: if they arrive at a river, they wind along the course of the stream.

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* SYNONYMS.—Cancer Ruricola. *Linn.*——Violet Crab.

They are as regular in their procession as an army under the direction of an experienced commander, being generally divided into three battalions. The first of these consists of the strongest males, which march forward to clear the route and face the greatest dangers. The main body is composed of females, which are sometimes formed into columns fifty or sixty yards broad and three miles deep. The first division is often obliged to halt from want of rain, and the females never come from the mountains till the rains have set in for some time. Three or four days after these the rear-guard follows, a straggling undisciplined tribe, consisting of males and females, but neither so robust nor so vigorous as the former.

They proceed chiefly in the night; but if it rains during the day they always profit by it. When the sun is hot they always halt till the evening. When terrified they run back in a confused and disorderly manner, holding up and clattering their nippers in a threatening attitude, and with these they sometimes tear off a piece of the skin. If in their journey any one of their body is so maimed as to be incapable of proceeding, some of them always fall upon and devour it. They march very slowly, being sometimes three months or upwards in gaining the shore.

When arrived at the coast they prepare to cast their spawn; for this purpose they go to the edge of the water, and suffer the waves to wash twice or thrice over their bodies: they then withdraw to seek a lodging upon land. In the mean time the spawn is excluded in a bunch from the body, and adheres to the barb under the tail. This bunch becomes as big as a hen's egg, and exactly resembles the roe of a herring. In this state they again, for the last time, seek the shore, and, shaking off the spawn into the water, leave accident to bring it to maturity. About two thirds of the eggs are devoured by the shoals of fish which annually frequent the shores in expectation of this prey. Those that escape are hatched under the sand; and not long after this, millions of the little crabs may be seen quitting the shore, and slowly travelling up to the mountains.

The old ones in their return are feeble, lean, and so inactive that they are scarcely able to crawl along, and their flesh at this time changes its colour. Many of them are obliged to continue in the level parts of the country till they recover, making holes in the earth which they block up with leaves and dirt. In these they cast their old shells, and continue afterwards nearly motionless for six or seven days, when they become so fat as to be delicious food. After this they march slowly back to the mountains.

They subsist on vegetables, and, except when impelled by the desire of bringing forth their young, seldom venture out from their mountainous retreats. At this season the inhabitants of the islands where they are found wait in eager expectation for their descent, and destroy some thousands of them . they disregard their bodies, and take only the spawn that lies on each side of the stomach within the shell, about the thickness of a man's thumb. They are much more valuable for eating on their return, after they have cast their shells. They are taken in the holes; and also sought for by night, when on their journey, by flambeaux. The instant the animals perceive themselves attacked, they throw themselves on their back, and with their claws pinch most dreadfully whatever they happen to fasten on. But the crab-catcher seizes them by the hinder legs in such a manner that the nippers cannot touch him. They are caught in their holes by the sea-side, by so fixing a stick as to prevent their escaping; and soon afterwards the tide entering the holes, the animals are drowned. Wafer says, that the inhabitants of some of the Caribbee islands, when they have taken them, put them for three or four days into a piece of potatoe ground in order to render them more firm, and better eating*.

In general shape these animals are not much unlike the Black-clawed Crab; and the largest of them measure about six inches across the body. They vary in colour, but are in general of a blackish violet: some are entirely black, others yellow, or red, and others variegated. They are distinguished from other species of Crabs by having the first joint of the legs spinous, and the second and third furnished with tufts of hair.

THE BLACK-CLAWED CRAB†.

This species of Crab is found on the rocky coasts both of Europe and India; and is the same that is introduced to our tables, being in greater esteem as food than most others of the tribe.

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* See Browne's Jamaica, p. 423.—Sloane, ii. 269.—Catesby, ii. 32.——Smith's Nevis, p. 16.——Wafer's Voyage, p. 111.

† Cancer Pagurus. Linn.

The most remarkable circumstance in the history of these animals is the changing of their shells and broken claws. The former is done once a year, and that usually between Christmas and Easter. During the operation they retire among the cavities of rocks and under great stones; and Dr. Darwin says (from the authority of a friend who had been engaged in surveying the sea-coasts) that a hard-shelled Crab always stands sentinel to prevent the sea insects from injuring the rest in their defenceless state; and that, from his appearance, the fishermen know where to find the soft ones, which they use for baits in taking fish: adding—that though the hard-shelled Crab, when he is on his duty, advances boldly to meet the foe, and will with difficulty quit the field, yet at other times he shows great timidity, and has a wonderful speed in attempting his escape; and, if often interrupted, will pretend death, like the spider, and watch an opportunity to sink himself into the sand, keeping only his eyes above.

In the under part of the shell a crescent-formed suture may be observed, which opens at the casting of the shell, and leaves a space sufficient for drawing out the whole body: the thorax soon after drops its breast-plate, and then the legs quit their crustaceous coverings. The body is now only enveloped in a soft skin not unlike wet parchment; and the animal is so helpless as for a while to be incapable of motion, but lies between the rocks till it has acquired sufficient strength and hardness to bear the weight of its body, and convey itself from place to place to perform its usual functions. The old shell is left, in two divisions, one that covered the body, and the other that inclosed the legs. It is asserted that the stomach and intestines are also cast with the skin; and that the first food the animal takes after recovering its strength is the old stomach. It sometimes happens that the shell hardens prematurely, and fixes the animal a prisoner in his crevice; for fishermen have often found them thus immured. When Crabs are out of health they do not change their shells regularly, the old shells always remaining till they have recovered their proper strength and vigour.

When the fishermen take a Crab that is not in good condition they return it into the sea, and sometimes mark it on the back with a sharp-pointed instrument, or the end of a knife; and it is very surprising that this mark may not only be seen to remain on the old shell, but that it is also found impressed on the subsequent new one. These men also say that when a Crab has had its shell marked, and been carried out to the distance of two or three miles, and thrown among others, it will always find its way back again, as they have many times observed by afterwards catching them in their former haunts.

When the claw of a Crab is bruised it bleeds, and the animal seems by its motions to experience much pain. For a while it moves it from side to side; then, holding it perfectly steady in a direct position, the claw on a sudden gives a gentle crack, and the wounded part drops off, not at the joint, as has been generally said, but in the smoothest part of the limb; "just (says Mr. Collinson) as one sees the neck of a retort separate when it has been heated by a red-hot iron ring, on the application of cold water." If, however, the wound happens to be at the extremity of the claw, the animal is said generally to bleed to death, or to pine away in consequence of the slow and almost insensible leaking of the vital moisture.

Crabs are naturally very quarrelsome, and frequently have serious contests by means of those formidable weapons, their great claws. With these they lay hold of their adversary's legs, and wherever they seize it is not easy to make them forego their hold. The other animal seized has, therefore, no alternative but to leave part of the leg behind in token of victory.

Mr. Collinson was shown an experiment to prove the extremely tenacious disposition of the Crab. A fisherman by irritation made one of them seize one of its own small claws with a large one. The foolish creature did not distinguish that it was itself the aggressor, but exerted its strength and soon cracked the shell of the small claw. Feeling itself wounded it cast off the piece in the usual place, but continued to retain the hold with the great claw for a long time afterwards.

Fishermen say that the Crab will live confined in a pot or basket for several months, without any other food than what is collected from the sea-water, and that even in this situation it will not decrease in weight*.

THE HERMIT CRAB†.

The Hermit Crab is usually about four inches long. It has no shell behind, but is covered down to the tail with a rough skin, terminating in a point. It is armed with two strong hard nippers before, one of which is as thick as a man's thumb, and pinches most powerfully.

Having no shell to any part but its nippers, it supplies by art what is denied to it by nature: for, taking possession of the deſerted shell of some other animal, it occupies that, till, by becoming too large for its habitation, it is under the necessity of changing it.

It is curious enough to observe this animal busily parading the sea-shore, along that line of pebbles and shells that is formed by the farthest wave; still, however, dragging its old incommodious habitation at its tail, unwilling to part with one shell, even though a troublesome appendage, till it can meet with another more convenient. It stops first at one shell, turns it, passes by; then goes to another, contemplates that for a while, and, slipping its tail from the old habitation, tries on the new. This alſo is found inconvenient, and it quickly reſumes the old one. In this manner it frequently changes, till at length it finds one light, roomy, and commodious. To this it adheres, though the shell be sometimes so large as to hide both the body and claws of the animal.

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* Collinson in Phil. Tran. vol. xliv. p. 70.—Vol. xlvii. p. 41.

† Cancer Bernhardus. Linn.

But many trials and many combats are sometimes to be sustained by the Hermit Crab before he is thus completely equipped: for there is often a contest between two of them for some favourite shell, to which they are rivals. They both endeavour to take possession. They strike with their claws, and bite each other, till the weakest is compelled to yield. The victor then takes possession, and in his new acquisition parades backward and forward on the strand before his envious antagonist.

When this animal is caught, it emits a faint cry; but pinches forcibly with its claws; nor is there any mode of getting disengaged from these but by either breaking them off or heating the shell. It feeds on fish and insects.

THE LOBSTER*.

Lobsters are found on most of the rocky coasts of Great Britain. Some are taken with the hand; but the greater quantity in pots, a sort of traps formed of twigs, and baited with garbage. These are formed like a wire mouse-trap, so that when the lobster gets in there is no return. They are fastened to a cord sunk into the sea, and their place is marked by a buoy.

These animals are extremely prolific; Dr. Baster says he counted 12,444 eggs under the tail of a female lobster, besides those that remained in the body unprotruded. They deposit these eggs in the sand, where they are soon hatched.

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* Cancer Gammarus. *Linn.*

They change their crust annually. Previous to their putting off the old one, they appear sick, languid, and restless. They totally acquire a new shell in a few days; but during the time that they remain defenceless they seek some lonely place, lest they should be attacked and devoured by such of their brethren as are not in the same weak situation.

At the same time that they cast their shell they change also their stomach and intestines. The animal, while it is moulting, is said to feed upon its former stomach, which wastes by degrees, and is at length replaced with a new one.

The pincers of one of the lobster's large claws are furnished with nobs, and those of the other are always serrated. With the former it keeps firm hold of the stalks of submarine plants, and with the latter it cuts and minces its food very dexterously. The knobbed or numb claw, as the fishermen call it, is sometimes on the right, and sometimes on the left, indifferently. It is more dangerous to be seized by the cutting claw than the other; but, in either case, the quickest way of getting disengaged from the creature is to pluck off its claw.

In casting their shells it is difficult to conceive how the lobsters are able to draw the fish of their large claws out, leaving the shells of these entire and attached to the shell of their body; in which state they are constantly found. The fishermen say the lobster pines before casting, till the fish in its large claw is no thicker than the quill of a goose, which enables it to draw its parts through the joints and narrow passage near the trunk. The new shell is quite membranaceous at first, but hardens by degrees. Lobsters only grow in size while their shells are in their soft state.

In the water they can run nimbly upon their legs or small claws, and if alarmed can spring, tail foremost, to a surprising distance, as swift as a bird can fly. The fishermen can see them pass about thirty feet, and by the swiftness of their motion it is supposed that they may go much farther. When frightened they will spring from a considerable distance to their hold in the rock, and, what is not less surprising than true, will throw themselves into their hold in that manner, through an entrance barely sufficient for their bodies to pass; as is frequently seen by the people who endeavour to take them at Filey Bridge, near Scarborough.

The circumstance of Lobsters losing their claws at thunder-claps, or on the sound of cannon, is well authenticated; and the fishermen are often jestingly threatened with a salute by the sailors. The restoration of claws thus lost may always be observed; for these never again grow to their former size. When the claws of Lobsters become inconvenient, from being by any means injured, they always break them off[*].

THE CRAW-FISH[†].

In the breaking of the claw of the common Craw-fish, it has been observed that, about a day or two after the piece is cast off, a red membrane, not unlike a bit of red cloth, closes up the aperture. This is at first plain; but in the course of four or five days it assumes a convexity, which gradually augments till it takes the appearance of a small cone, which exceeds not a line in height. It continues, however, to stretch out, and in ten days it is ſometimes more than three lines, or about a quarter of an inch high. It is not hollow, but filled whith flesh, and this flesh is the basis or rudiment of a new claw. The membrane that covers the flesh performs the same office to the young claw as the membranes do to the fœtus of the larger animals. It extends in proportion as the animal grows; and, as it is pretty thick, we can perceive nothing but a lengthened cone. When fifteen days are elapsed this cone inclines toward the head of the animal. In a few days more its curvature increases, and it begins to assume the appearance of a dead claw. This claw, though at the end of a month or five weeks it has acquired the length of six or seven lines, which is more than half an inch, is still incapable of action. The membrane in which it is inclosed becoming gradually thinner in proportion as it extends, gives an opportunity of observing the parts of the claw, and we now perceive that this conical substance is not a simple congeries of flesh. The moment is now arrived when the claw begins to be brought forth. The membrane at last bursts, and the new claw, though still soft, appears without incumbrance or investment. In a few days more it is covered with a shell; and though still delicate, and not the half of its former length, it is able to perform all the natural functions. It has likewise been discovered, that, whether the claw has been lopped off at the fourth articulation, or any where else, the animal in a short time recovers all that it had lost. The same reproduction takes place also in the horns; but, if the tail is cut off, the animal survives a few days only.

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[*] Penn. Brit. Zool. vol. iv. p. 9.

[†] Cancer astacus. *Linn.*

The Craw-fish are found in many of our rivers, lodged in holes which they form in the clayey banks; and their presence is generally esteemed an evidence of the goodness of the water. They are frequently taken by means of sticks split at the end, with a bait inserted in the cleft, and stuck in the mud at the distance of a few feet from each other. These sticks after remaining some time are taken up, generally with an animal adhering to each. They are gently drawn out of the mud, and a basket is put under them to receive the animals, which always drop off when brought to the surface of the water.

CANCER STAGNALIS.

This species is found in the small shallows of rain-water which are so frequent in spring and autumn, and in which numerous kinds of animalcula usually abound. Its length is about an inch and a half; and it has on each side ten legs, appearing like so many delicately-formed waving fins. The whole animal is transparent, and its general colour is very light brown with a tinge of blueish green, particularly on the head and shoulders. The head of the male is armed with a pair of strong fangs that end in two long hooks bending inwards. The female is without these, and just under the origin of the tail has a large oval, sharp-pointed bag of ova. The tail in both is red, and ends in two sharp points.

This little creature seems to delight much in sunshine, during which it appears near the surface of the water, swimming on its back, and moving in various directions by means of its numerous fin-like legs, at the same time evidently using its tail as a rudder to steer itself along. The moment any thing alarms it, it starts off like a small fish, and endeavours to secrete itself by diving into the mud.

That it changes its skin is evident from the sloughs that are frequently to be seen in the water in which these animals are kept.

The females deposit their eggs in March and April, without any settled order, and perfectly loose in the water. These are very small, of a light brown colour, and appear, when viewed through a pretty strong magnifying power, to be thickly set on all sides with sharp spines: they are also coated over with a transparent substance reaching to the extremities of these little prickles. This peculiarity of structure may have been intended by the all-wise Author of Nature, either to assist them in adhering to the substances on which they fall, or to afford them a security from the attacks of inimical insects.

In about a fortnight the young tribe make their appearance, but when first hatched they are little larger than a common mite. They may soon be seen to swim about with great liveliness by means of three very long pair of arms, or rowers, which seem much disproportioned to the size of the animals. In this state they bear not much resemblance to the animal in a perfect state. In the short space of a few hours the body lengthens, and the divided tail-fin, so remarkable in the parent, begins to shew itself. The eyes are now only like a dark spot on the middle of the head. They continue to approach their perfect form for some days, when at length they throw off their covering and appear complete.

These insects may be kept in glasses in a room. The glasses should be small, with only a single female in each, which as soon as she has laid her eggs must be removed*.

THE SCOLOPENDRA †.

The Scolopendra have tapering antennæ, and two thread-shaped feelers united between the jaws. The body is long, depressed, and consists of numerous transverse segments; and there is the same number of legs on each side as there are segments of the body.

They live chiefly on other insects; and inhabit decayed wood, or hollows under stones. The species that frequent the hot climates are large, and many of them very venomous.

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* Linn. Tran. i. 103—110. tab. 9.

† Shaw's Nat. Mis. tab. 9.

THE CENTIPEDE.

None of the Insect tribe, the scorpions excepted, are so formidable in appearance as the Centipede. It is found in the East and West Indies, and in various parts of Africa, inhabiting chiefly the woods, where it is preyed upon by the different species of snakes. It is, however, sometimes found in houses, and is said to be so common in particular districts, that the inhabitants are obliged to have the feet of their beds placed in vessels of water, to prevent their being annoyed during the night by these horrible reptiles*.

They vary greatly both in size and colour. Some of them are of a deep reddish brown, others yellow ochre colour, livid yellow, or tinged with red: and they are sometimes seen above a foot in length, though they are generally much less. Their legs terminate in very sharp hooks or nails of a shining black colour; and all the other legs are furnished with smaller ones of the same kind.

Gronovius says that all the feet are venomous; but that the most formidable weapons of this creature are the two sharp, hooked instruments that are placed under the mouth, with which it destroys its prey. At the extremity of each of these is a small opening, and from thence a channel runs into the body of the animal. Through this channel it is supposed the Centipede emits the poisonous fluid into the wound inflicted by these fangs.

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* Synonyms.—Scolopendra morsitans. *Linn.*—Great Scolopendra. *Shaw's Nat. Mis.*

Leuwenhoek, desirous of ascertaining the influence of the poison, placed a large fly within the reach of a Centipede. He seized it between a pair of the middle feet, then passed it from one pair to the next, till it was brought under the fangs; which were plunged into its body, and it died instantly. St. Pierre says that in the Isle of France his dog was bitten by one of them that was upwards of six inches in length, and that the wound turned to a kind of ulcer which was three weeks in healing. He was highly diverted in observing one of them overcome by a vast number of ants, that attacked it in conjunction, and, after seizing it by all its legs, bore it along as workmen would have done a large piece of timber *. Its poison is not more injurious than that of the scorpion, and very seldom proves fatal to the larger animals.

Sir George Staunton says, that such was the horror excited in the minds of some of lord Macartney's train by the sight of these creatures, that many thought them alone a sufficient objection to the country.

They have eight very small eyes, four on each side of the head, near the antennæ. As they become older the number of segments of the body increase, so that it is sometimes difficult to ascertain the species †.

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* St. Pierre's Voyage to the Isle of France, p. 79.

† Donovan's Insects of China.

WORMS.

NEARLY all the animals of this, the lowest class of animal being, possess but slow loco-motive powers. Their bodies are soft, fleshy, and destitute of articulated members; some of them have hard internal parts, and others have crustaceous coverings. Many of them have arterial and veinous vessels, in which the blood undergoes a real circulation, but these are by no means common to the whole class. In some of them eyes and ears are very perceptible, while others seem to enjoy only the senses of taste and touch, which are never wanting. Many have no distinct head, and most of them are without feet. The whole of these creatures are very tenacious of life, and most of them are able to increase their bulk, and restore parts that have been destroyed.

They are divided into five orders, Intestinal, Molluscous, and Testaceous Worms, Zoophytes, and Animalcules*.

1. *Intestinal Worms.* These are simple naked animals, without limbs, that live some of them within other animals, some in water, and a few in

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* Intestina, Mollusca, Testacea, *Zoophyta*, and Infusoria of Linnæus.

earth. The Ascarides, Tape-worms, Leeches, and Common Worms, are illustrations of this order.

2. *Molluscous Worms.* These are simple animals without shells, and furnished with tentacula or arms: most of them are inhabitants of the sea, and many possess a phosphorescent quality. The Sea Anemones, Cuttle-fish, Medusæ, Star-fish, and Sea-urchins, belong to the Molluscæ.

3. *Testaceous Worms:* are Molluscæ covered with calcareous shells, which they carry about with them; as the Muscles, Cockles, Oysters, Snails, &c.

4. *Zoophytes:* hold a rank between animals and vegetables, most of them taking root and growing up into stems and branches. Some of them are soft and naked, and others are covered with a hard shell.

5. *Animalcules:* are extremely minute, destitute of tentacula or feelers, and generally invisible to the naked eye. They are chiefly found in infusions of animal and vegetable substances of various kinds.

WORMS.

THE TAPE-WORMS, OR TÆNIÆ*.

TÆNIÆ are worms that inhabit the bodies of different animals, where they are destined to feed upon juices already animalized. They are generally found in the alimentary canal, and usually about the upper part of it, where there is the greatest abundance of chyle, which seems to be their natural food.

In structure they are very simple; for, being intended to be nourished by already digested food, they are not provided with complicated organs of digestion.

Their body is flat, and composed of numerous articulations; and the head has four orifices for suction a little below the mouth, which is terminal, and continued by a short tube into two ventral canals. The mouth is generally crowned with a double series of retractile hooks or holders.

We are not to suppose that these worms are created for the purpose of producing disease in the animals they inhabit, but rather that nature has directed that no situation should be vacant, where the work of multiplying the species of living beings could be carried on. By thus allowing them to exist within each other the sphere of increase is considerably enlarged. There is, however, little doubt that worms, and more especially those of the present genus, do sometimes produce diseases in the bodies they inhabit: but we are at the same time very certain, that worms do exist abundantly in many animals without at all disturbing their functions or annoying them in the slightest degree: and we ought to confider all these creatures rather as the concomitants than the causes of disease.

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* The Linnean order of INTESTINAL WORMS commences with this tribe.

The species of Tæniæ are not confined *singly* to particular animals: men are subject to several different species, and even the people of particular countries and climates are subject to particular species of them. The people of England have the *Tænia Solium*, or Common Tape-worm, and rarely any other: the inhabitants of Switzerland the *Tænia lata*, &c.

These creatures are apparently possessed of few senses. Nothing resembling brain or nerves has been discovered; but, as they are highly sensible to stimuli, it is most reasonable to conclude that they have a considerable portion of nervous matter in the composition of their bodies, that is, of such matter as is susceptible of stimuli. Indeed we can scarcely conceive how any animal can even exist without such matter in its composition. Having no particular organs of sense, the touch is therefore the only evident source of intelligence which they possess.

The mode of increase or propagation of Tæniæ appears to be principally by ova; and there is reason to believe that these ova, as well as those of other intestinal worms, are so constructed as not to be easily destroyed. From this circumstance we may suppose them to pass along the circulating vessels of other animals. We cannot easily explain the phenomena of worms being found in the eggs of fowls, and in the intestines of a fœtus before birth, except by supposing their ova to have passed through the circulating vessels of the mother, and been by this means conveyed to the offspring *.

THE COMMON TAPE-WORM †.

The head of this animal is furnished with a mouth, and with an apparatus for giving it a fixed situation. The body is composed of a great number of distinct pieces articulated together, each joint having an organ by means of which it attaches itself to the inner coat of the intestine; and as these joints are sometimes exceedingly numerous, so of course will be the different points of attachment. The joints nearest the head are always small, and they become gradually enlarged as they are farther removed from it, except towards the tail, where a few of the last joints become again diminished. The body is terminated by a small semicircular joint, which has no opening.

The external parts are clothed with a fine membrane-like cuticle, immediately under which is a thin layer of fibres, lying parallel to each other, and

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* Carlisle on the Tæniæ, Linn. Tran. ii. 247. tab. 25.

† Tænia Solium. *Linn.*

running in the direction of the length of the animal's body. In this direction all its motions are performed; from whence we may conclude that these fibres perform the office of muscles.

The head has a rounded opening at its extremity, which is considered to be the mouth. This opening is continued by a short duct into two canals, which pass round every joint of the animal's body, and convey the aliment. The head is fixed to its place by means of two small tubercles, concave in the middle, that seem to serve the purpose of suckers. The alimentary canal passes along each side of the animal, sending a cross canal over the bottom of each joint, which connects the two lateral canals together. The internal structure of the joints is partly cellular and partly vascular: the substance itself is white, and in its texture somewhat resembles the coagulated lymph of the human blood.

The food of the Tæniæ requiring probably very little change before it becomes a part of their body, is taken in at the mouth, and, being propelled into the alimentary canal, is made to visit, in a general way, every part. The central structure of the vessels placed in each joint seems calculated to absorb the fluid from the alimentary canal, for the purpose of sustaining and repairing the immediately adjacent parts; but there is in their bodies much cellular substance, into which no vessels enter. Such parts of the bodies of these animals are possibly nourished by transudation of the alimentary fluid into their cells; or this may be effected by the capillary attraction of their fibres. As they have no excretory ducts, the decayed parts of their bodies are most probably dissolved into a fluid which transudes through the skin like perspiration, and with this view the skin is extremely porous.

The length of the present Tænia is generally from three to thirty feet; but it has been known to reach sixty feet, and to be composed of several hundred joints.

When these worms produce a diseased state of body, those remedies (as drastic purges) are supposed to be the most effectual that operate partly by irritating the external surface of their bodies, so as to make them quit their hold, and partly by violent contractions in the intestines, which may sometimes divide their bodies, or even destroy them by bruising *. Electrical shocks, passed frequently through the abdomen, it is supposed might be beneficial, as the lower orders of animals are in general easily destroyed by electrical shocks.

In injecting these Tæniæ with coloured size in order to preserve them, three feet in length from the head downwards has been filled by a single push with a small syringe: but the injection would not pass from below upwards beyond the joint, owing,

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* There is however reason to suppose that merely breaking them, unless the detached part comes immediately away, will not be altogether effectual, as this is generally understood to be capable of producing a new head, and thus becoming an independent animal.

as it is supposed, to a valvular apparatus situated in the lateral canals immediately below the places where the cross canals are sent off*.

FURIA.

The body in this tribe, of which only one species has yet been discovered, is linear, of equal thickness throughout, and has on each side a single row of close-pressed, reflected prickles.

THE GUINEA WORM†.

The Guinea Worm is a native of moist grounds, and is found both in the East and West Indies. It enters the naked feet of the slaves, and occasions very troublesome itchings, and sometimes excites even fever and inflammation. It particularly attacks the muscles of the arms and legs, from whence it is only to be extracted by means of a piece of silk or thread tied round its head. But the greatest caution is necessary in this simple operation, lest the animal, by being strained too much, should break; for, if any part remains under the skin, it grows with redoubled vigour, and becomes a cruel and sometimes a fatal enemy.

Dampier tells us that these worms are no thicker than a large brown thread, but, as he had been informed, five or six yards long. "If they break in drawing out, that part which remains in the flesh will putrefy, be very painful, and endanger the patient's life, or at least the use of the limb; and I have known some that have been scarified and cut strangely to take out the worm." He was unfortunate enough to have one of these creatures in his own ankle. "I was (he says) in great torment before it came out: my leg and ankle swelled, and looked very red and angry, and I kept a plaster to it to bring it to a head. At last, drawing off my plaster, out came about three inches of the worm, and my pain abated presently. Till then I was ignorant of my malady, and the gentlewoman at whose house I was took it for a nerve; but I knew enough what it was, and presently rolled it up on a small stick. After that I opened the place every morning and evening, and strained it out gently about two inches at a time, not without some pain, till at length I had got out about two feet." He afterwards had it entirely destroyed by one of the negroes, who applied to it a kind of rough powder, not unlike tobacco-leaves dried and crumbled very small.

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* Linn. Tran. ii. 250.

† Furia infernalis. *Linn.*

It is said that when the Guinea Worms cannot be laid hold of after they have come to life, they will move under the skin to different parts of the body, and what is one day seen in the breast or belly will often, in the course of a day or two, be found in another distant part, perhaps in the thigh or leg*.

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* Hughes's Natural History of Barbadoes.

M. D'Obsonville received in his right leg the germ of one of these worms. He observed that its head was of a chesnut colour, and that to the naked eye it appeared to terminate in a small black point. On pressing it a little with a pin, and examining it with a common magnifying glass, he fancied he perceived something like a little trunk or tongue, capable of being pushed out or contracted. The body was not thicker than a strong thread; but when the animal was extracted, it was found to be of the length of two or three ells. It appeared to be formed of a series of small rings, united to each other by an exceedingly fine membrane, and a single intestine extended through the body. It was extracted in the usual way; and the reason he gives for the injury done by breaking these animals is, that they are full of a whitish acrimonious lymph, which immediately excites inflammation, and not unfrequently produces afterwards an abscess or gangrene. The worm in his leg was twice broken, and twice occasioned an abscess. At last, at his own request, the part affected was rubbed with a preparation of mercury: and in eight or ten days the effect surpassed his hopes; for not only the body of the insect came away in suppuration, but the wound also, which was then more than three inches long, and considerably inflamed, was in this time almost entirely healed *.

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* D'Obsonville, p. 41.

THE HAIR-WORMS.

These animals are inhabitants chiefly of stagnant waters. Their body is round, thread-shaped, equal throughout, and smooth.

THE COMMON HAIR-WORM[*].

This worm is about the thickness of a horse's hair, and, when full grown, is ten or twelve inches in length. Its skin is somewhat glossy, and of a pale yellowish white, except the head and tail, which are black. It is common in our fresh waters, and particularly in such where the bottom is composed of soft clay, through which it passes as a fish does through water[†].

Its popular name arose from the idea that it was produced from the hair of horses and other animals that were accidentally dropped into the water; an idea that is even yet prevalent among the lower class of the people.

Its Linnean name of Gordius originated in the habit that it has of twisting itself into such peculiar contortions as to resemble a complicated gordian knot. In this state it often continues for a considerable time, and then slowly disengaging itself extends its body to the full length.

Sometimes it moves in the water with a tolerably quick undulating motion like that of a leech; and at other times its motions are the most slow and languid imaginable. When the water in which it swims happens to be dried up, it soon loses every appearance of life; the slender body shrivels, and it may be kept in this state for a great length of time. But whenever it is put into water its body soon reassumes its former appearance; in less than half an hour it begins to move, and in a few minutes more it is as brisk and active as ever it was. How long it might be preserved in this dried state without losing its life, or how it might admit of being revived, has not been ascertained. When kept in a vessel of water, it will sometimes appear motionless and as if dead for several hours, and afterwards will resume its former vigour, and seem as healthy as before.

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[*] Gordius aquaticus. *Linn.*——Water Hair-worm. *Barbut.*

[†] Barbut's Genera Vermium, p. 7. tab. 1.

It is a very remarkable circumstance, that its bite, which it sometimes inflicts on being taken out of the water, has been known to produce the complaint called a whitlow. This is mentioned by Linnæus as a popular opinion in Sweden, and it has since his time been confirmed by various other persons.

This Gordius is sometimes found in the earth as well as in water, and particularly in gardens, of a clayey soil, after rain *.

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* Shaw's Nat. Mis. iv. tab. 121.—Anderson's Recreations, ii. 255.

THE EARTH-WORMS.

The Earth-worms have a round annulated body, with generally an elevated fleshy belt near the head. Most of the species are rough, with minute concealed prickles placed longitudinally, and have in the body a lateral aperture.

THE DEW-WORM *.

The most insignificant insects and reptiles are of much more consequence, and have much more influence in the economy of nature, than the incurious are aware of; and are mighty in their effect, from their minuteness, (which renders them less an object of attention,) and from their numbers and fecundity. Dew-worms, though in appearance a small and despicable link in the chain of nature, yet, if lost, might make a lamentable chasm. For, to say nothing of half the birds and some quadrupeds which are almost entirely supported by them, worms seem to be the great promoters of vegetation, (which would proceed but ill without them,) by boring, perforating, and loosening the soil, and rendering it pervious to rains and the fibres of plants, by drawing straws and stalks of leaves and twigs into it; and, most of all, by throwing up such infinite numbers of lumps called worm-casts, which form a fine manure

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* Lumbricus terrestris. *Linn.*

for grain and grass. Worms probably provide new soil for hills and slopes where the rain washes the earth away; and they affect slopes, probably, to avoid being flooded.

Gardeners and farmers express their detestation of worms; the former, because they render their walks unsightly, and make them much work; and the latter, because they think worms eat their green corn. But these men would find, that the earth without worms would soon become cold, hard-bound, and void of fermentation; and consequently sterile: and besides, in favour of worms, it should be hinted that green corn, plants, and flowers, are not so much injured by them as by many species of insects in their larva or grub-state; and by unnoticed myriads of those small shell-less snails called slugs, which silently and imperceptibly make amazing havoc in the field and garden.

Lands that are subject to frequent inundations are always poor: one great reason of this may probably be, because all the worms are drowned.

The Dew-worm is without bones, without brain, eyes, and feet. It has a number of breathing-holes along its back, adjoining to each ring. Near its head is placed the heart, which may be observed to beat with a very distinct motion. The body is formed of small rings furnished with a set of muscles that act in a spiral direction, and which enable it in the most complete manner possible to penetrate into or creep upon the earth. The motion of these creatures may be explained by a wire wound on a cylinder; where, when one end is drawn on and held fast, the other, upon being loosed, will immediately follow. These muscles enable them with great strength to dilate or contract their bodies. The annuli or rings are also each armed with small, stiff, and sharp beards or prickles, which they have the power of opening out or closing to their body. And under the skin is secreted a slimy matter, which they emit at the perforations between the annuli, to lubricate the body, and facilitate their passage into the earth. By all which means they are enabled with great ease to perforate the earth; which, had their bodies been otherwise constructed, they could not so well have done.

Helpless as they may seem, these creatures are very vigilant in avoiding such animals as chiefly make them their prey. The mole in particular, who feeds almost entirely upon them, they avoid by darting up from the earth the instant they feel the ground move. The fishermen, who are well acquainted with this circumstance, take them in any numbers they chuse, by moving the earth in places where they expect to find them.

In winter they retire very deep into the earth, and stop up their holes with leaves or straws to prevent the frosts from injuring them.

THE LEECHES.

THE body of the Leech is oblong and truncate, or as if cut off at both ends. These animals are cartilaginous, unarmed, and move by dilating the head and tail, and contracting themselves into the form of an arch.

THE MEDICINAL LEECH *.

This species is usually found in stagnant ponds and ditches, and is of an olive black colour, with six yellowish lines above, and spotted with yellow beneath. It is generally two or three inches in length. The body is formed with numerous annular wrinkles, which it has the power of expanding or contracting at pleasure. The tail ends in a circular muscle or sucker, which when applied to any substance readily adheres, by the animal's drawing up the middle so as to have it pressed firmly down by the external air. By this it fastens itself with ease and security, while it extends the other part of the body in any direction: and it is so firmly fixed, that it can move its head about to seek for nourishment, without any danger of being carried away by the strength of the current. When the animal is desirous of moving on, it extends its body forwards, fixes its head in the same manner that it did its tail, and then loosens and draws that up, and again fastens it near its head as a fresh point to proceed from.

The head of the Leech is armed with three teeth of a slightly cartilaginous substance, which are so situated as to converge when the animal bites, and leave a somewhat triangular mark on the skin. These are sufficiently strong to pierce the skin of an ox or

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* Hirudo medicinalis. *Linn.*

a horse. Through the holes it forms with them it sucks the blood: this is done by contracting the muscles of the throat, so as to make the blood rush through the vacuum above the wound into the stomach, which is a kind of membranaceous skin divided into twenty-four small cells. Here it sometimes remains for several months almost without coagulating, and affords support to the animal during the whole time. It passes off by transpiration, the matter fixing on the surface of the body, and afterwards coming off in small threads. In proof of this, if a leech be immersed in oil, (where it will keep alive for several days,) and afterwards put into water, a kind of slough will be seen to loosen from its skin, exactly of the shape of the body.

The Leech is a viviparous animal, producing one young at a time, and this about the month of July. When confined in a glass, and kept in a room, it is said to be always very restless before a change of weather.

When it is applied in surgery, and is found to adhere too long, it is easily removed by putting upon it salt, pepper, or acids.

THE SLUG TRIBE *.

THE body of the Slug or naked Snail is oblong: and the animals have a fleshy kind of shield above, and move along by means of a longitudinal flat disk beneath. On the right side of the shield is an aperture. They have four feelers situated above the mouth, with an eye at the extremity of each of the larger ones.

THE SPINNING SLUG †.

About the year 1789 Mr. Hoy observed, in a plantation of Scotch firs, something hanging from one of the branches, which, as it seemed uncommon, he approached, and found to be this animal. It was hanging by a single line or thread attached to its tail. This was, upwards, very fine; but near the animal it became thicker and more broad, till at length it exactly corresponded with the tail. The slug was about four feet below the branch, and nearly at the same distance from the ground; which it gra-

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* The Linnean order of MOLLUSCOUS WORMS commences here.

† Limax agrestis. *Linn.*——Spinning Limax. *Linn. Tran.*

dually approached at the rate of an inch in about three minutes[*]. This rate, though slow, is not so much so as might be expected, considering that the animal is not furnished with any peculiar receptacle, as in some insects, for the glutinous liquid from which its silken lines are formed. The line by which it descended was drawn from the slimy exudation gradually secreted from the pores that covered its whole body. A great degree of exertion seemed necessary to produce a sufficient supply of the liquid, and to force this towards the tail. It alternately pushed out and drew back its head; and turned it as far as possible, first to one side and then to the other, as if thereby to press its sides and thus promote secretion. This motion of the head in an horizontal direction made the whole body turn round; by which the line, which would have otherwise remained somewhat flat, became round. This motion also, no doubt, in addition to the weight of the animal, tended materially towards lengthening the line[†].

This is the substance of Mr. Hoy's account. Dr. Latham says, that the secretion from which the thread is formed is wholly from the under parts of the animal, and not from the back or sides, both of which during the operation appear nearly dry. That it did not proceed from any orifice in the tail was evident; for in some experiments the animal was suspended by the tip, and at other times from the side a full eighth of an inch from the tip. The flow of the viscous secretion towards the tail appeared to be excited by means of an undulating motion of the belly, similar to that of crawling.

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[*] It has been observed by Dr. Latham to descend about three inches and a half in a minute.

[†] Mr. Hoy in Linn. Tran. i. 183.

After having spun for some time, their power seems for a while to be lost: but in those on which experiments have been made, it has always been recovered after their being kept some hours among wet moss*.

This slug is of a greyish white colour, with a yellowish shield, and is generally about three fourths of an inch in length. It is supposed not to be very uncommon in woods and other shady places.

THE NEREIS TRIBE.

THE animals of this tribe are long and slender. Their feet are very numerous, and arranged on each side of the body. They have in general two or four eyes, but some of the species have none. Their feelers are simple, and placed above the mouth.

THE NIGHT-SHINING NEREIS†.

The body of this little creature is oblong, linear, and so minute as to elude examination by the naked

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* Latham in Linn. Tran. iv. 85.

† Nereis noctiluca. *Linn.*

eye. It inhabits every sea, and is one of the causes of the luminous shining of the water in the night, which is sometimes so great as to make that element appear as if on fire all around. The body, composed of about twenty-three segments or joints, is altogether scarcely two lines long; quite pellucid, and its colour that of water green.

These animals are found on all kinds of marine plants; but they often leave them, and swim on the surface of the water. They are frequent at all seasons, but particularly in summer before stormy weather, when they are more agitated and more luminous than at other times. Their numbers, and wonderful agility, added to their pellucid and shining quality, do not a little contribute to their illuminating the sea; for myriads of these animalcules may be contained in a small cup of sea-water. Innumerable quantities of them lodge in the cavities of the scales of fishes, and to them probably the fish may in some measure owe their shining quality. "I have observed with great attention (says Barbut) a fish just caught out of the sea, whose body was almost covered with them, and have examined them in the dark: they twist and curl themselves with amazing agility, but soon retire out of our contracted sight; probably on account of their glittering numbers dazzling the eye, and their extreme minuteness eluding our researches. It is to be observed, that when the unctuous moisture which covers the scales of fishes is exhausted by the air, these animals are not to be seen; nor are the fishes then noctilucous, that matter being perhaps their nourishment when living, as they themselves afford food to many marine animals. They do not shine in the day-time, because the solar rays are too powerful for their light, however aggregate, or however immense their number*."

Their appearance is particularly brilliant when the wind is in the east and south-east points, and in winter nights preceded by a warm day. If water containing these animalcules be kept warm, they will retain their light two whole days after they are dead; but in cold weather they lose it in the course of seven or eight hours. Motion and warmth, which increase their vivacity and strength, increase their light also.

THE ACTINIÆ.

These animals are somewhat oblong, and when closed resemble a truncated cone. They are fixed by the base, and from their top occasionally extend several tentacula, which are disposed in regular circles. The mouth, which is the only opening in the body, is placed at the top, in the centre of the tentacula, and is furnished with crooked teeth.

They are all capable of varying their figure: but when their tentacula are fully expanded they have the appearance of full-blown flowers. Many of

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[*] Barbut's Genera Vermium.

them are of very beautiful and brilliant colours. They feed on shell-fish and other marine animals, which they draw into their mouth with their arms; and they eject the shells and other indigestible parts through the same opening. It sometimes happens, however, that a shell presents itself in a wrong position, and the animal is not able to discharge it in the usual manner: in this case we are told that it is forced through the body, making a wound, as if with a knife, near the base. The arms seem to lay hold of objects by making a vacuum; for on touching them with the fingers they readily adhere, but no viscous matter is deposited by them. Their mouth is capable of great extension, so as to allow them to swallow very large shells without injury. The whole interior part of their body is one cavity or stomach. They have the power of progressive motion: but this is extremely slow, and is said to be performed by loosing their base from the rock, reversing their body, and employing their tentacula as so many legs.

Nearly all the animals of this genus may be separated from their native rocks by means of a card carefully introduced beneath, so as not materially to injure them; and being put into glass vessels with sea-water, which must be changed about once a week, they will there fix themselves, and may be kept alive and in full vigour for a great length of time in places far distant from the sea-coasts.

They are all viviparous.

THE SEA ANEMONE*.

The present species is extremely common on several of the European coasts, and on the sea rocks of this island in particular. It adheres by its base firmly to the rocks, so as frequently to be left above water at the ebbing of the sea: but it is generally found adhering at some little depth below the surface of the water. Its general colour is a deep red, more or less vivid in different specimens; and it is generally about two inches broad at the base, and of nearly the same height when closed. Its form is that of a very obtuse cone, with an orifice at the top, which it can at pleasure either close entirely, or extend very wide, to admit its tentacula to spread out, and to receive such food as they draw into it. These tentacula are varied with red in such manner, as, when fully expanded, to bear a very considerable resemblance to the flower of some of the garden Anemones. In the middle is the large cavity of the mouth; into which if any extraneous substance is introduced, or even if any of the tentacula are but slightly touched, the animal instantly contracts itself into a conoid shape again.

THE PURPLE ANEMONE†.

On this species the abbé Dicquemaire made several experiments to prove its powers of reproduction, &c. He first cut off all its tentacula, which grew again in less than a month; and on repeating this a second and third time, he had equal success. One of them had its upper part cut off: the base was found a few days afterwards to have fallen from its place, but it soon entirely recovered its limbs. After cutting one of them in two, the abbé offered a piece of a muscle to the detached part, and the limbs seemed eager to take it: they drew it into the mouth, and it was swallowed: but, as the body was wanting to receive it, the piece came out at the opposite end; "just (says the abbé) as a man's head, being cut off, would let out at the neck the bit taken in at the mouth." It was offered a second time and again received, and retained till the following day, when it was thrown up at the mouth. In this manner it was fed for some time, the bits, when they did not pass through, appearing considerably altered on their re-appearance at the mouth.—If the base of any of the Anemones is injured by the incision, the wound generally proves mortal.

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* Actinia anemonoides, *Linn.*

† Actinia rufa. *Linn.*

On being put under the receiver of an air-pump, and having the air exhausted, these animals did not seem to experience any ill effects, or to perceive any difference betwixt this and their being in the open air: if their tentacula happened to be expanded they remained so, and not the least shrinking could be perceived.

Some of them lived upwards of twelve months without any other food than what the sea-water afforded them.

When shell-fish or pieces of other fish, or bits of raw meat, were offered, if not too large, they always took them. The shells, even if closed, they ejected in the course of a day or two, but perfectly cleared of their contents.

They bring forth their young alive at the mouth; and the abbé had them produced several times in his hands: these were generally from eight to twelve in number. Though some of them are at this time almost imperceptible, yet they immediately fix themselves and expand their tentacula in order to catch their prey.

These animals are destitute of eyes, yet they were always very evidently affected by light. If a candle was held over the glasses in which they were kept, and at such a distance as not to communicate any heat, they always closed, and did not again expand till the light was removed. When however they had been plentifully fed they closed much slower, or sometimes even remained open.

When boiled in sea-water most of the species acquire a firm consistence, and form a very palatable food, which may be eaten with perfect safety. Cats are remarkably fond of them when thus cooked. Their smell is not unlike that of a warm crab or lobster.

Among other experiments of the abbé Dicquemaire, he gave to two Actiniæ of different species (a grey and a yellow one) a narrow slice of fish, so laid that each had hold of an end. The yellow one however happened to seize the larger share. Each swallowed on by its respective end, till at length their mouths came in contact. The grey one seemed at first to get the better; but the other soon recovered its share, lost it again, and again recovered it.

These alternate victories lasted about three hours, till at last, the grey one losing its hold, the other obtained the prize. This sucked it in but slowly, and the grey one again ventured its mouth upon a last tug at the end still in sight: but the effort proved fruitless; the yellow champion gave a final pull and swallowed the whole. During this whole contention both the creatures seemed animated by considerable passion: but though they remained neighbours for a great while afterwards, they lived together very peaceably*.

THE SEA-MARIGOLD.†

Mr. Hughes, in his Natural History of Barbadoes, has given us a very minute account of this species, several individuals of which were discovered in that island some years ago. He calls it an animal flower, and seems to consider it as a sensitive plant, having many animal properties.

" The cave that contained these animals was," he says, "near the bottom of a rocky cliff facing the sea, in the north part of the island, in the parish of St. Lucy. The descent to it was steep and dangerous, being in some places almost perpendicular. The cave contained a natural bason of water about sixteen feet long and twelve broad, in the middle of which was a rock always covered with them.

" Round the sides of this, at different depths under the water, seldom, however, more than eighteen inches, are seen at all times of the year, seemingly fine radiated flowers of a pale yellow, or a bright straw-colour, slightly tinged with green.

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* Dicquemaire, in Phil. Tran. vol. lxiii. p. 361. tab. 16.

† Actinia Calendula. *Linn.*

"These have the appearance of a circular border of thick-set petals, about the size of and much resembling those of the single garden marigold.

"I have often attempted to pluck one of them from the rock to which they are fixed, but could never effect it. For as soon as my fingers came within two or three inches of it, it would immediately contract and close together its yellow border, and shrink back into the hole in the rock; but, if left undisturbed for three or four minutes, it would come again gradually into sight, expanding, though at first very cautiously, what seemed its leaves, till at last it appeared in its former bloom: it would, however, again recoil, with surprising quickness, when my hand approached within a little distance of it." This gentleman also attempted to touch it with his cane, and then with a slender rod; but the effect was the same. The motion of the water, caused by the immerſion of the arms and stick, was no doubt the cause of its invariably retreating when any attempt was made to touch it.

From the centre of the apparent flower proceeded four dark-coloured threads, somewhat resembling, says Mr. H., the legs of a spider: these, which were its arms or feelers, had a quick spontaneous motion from side to side.

Its body seemed to be a small dark-coloured tube, about as thick as a raven's quill, one end of which was affixed to the rock, and the other, which extended a little way from it, was encircled with the yellow border above mentioned.

Soon after the discovery of these surprising animals, great numbers of people came to see them: but as this was attended with some inconvenience to the person through whose grounds they were obliged to pass, he resolved to destroy the objects of their curiosity; and that this might be done effectually, he caused all the holes out of which they appeared to be carefully drilled with an iron instrument. He could not, however, even by this mean, keep them down; for in the course of a few weeks they again appeared in the very same places, and in a ſhort time became as numerous as before.

THE CUTTLE-FISH TRIBE.

The Cuttle-fish, though comparatively large animals, some of them being two feet long and upwards, are ranked by Linnæus under the class of *Worms*. Their structure is remarkable. The body is cylindrical, and, in some of the species, entirely covered with a fleshy sheath; in others, the sheath reaches only to the middle of the body. They have eight tentacula, or arms, besides two feelers, as they are called, which are much longer than the arms. Both the feelers and arms are furnished with strong circular cups or suckers, by means of which the anima seizes its prey, and firmly attaches itself to rocks or other hard substances. To do this it applies their surface, extended and plain, to the surface of the body, and then drawing them up in the centre by muscles contrived for the purpose, a vacuum is formed, and they adhere by the pressure of the external air. The adhesive power is so great that it is generally more easy to tear off the arms than separate them from the substance to which they are fixed. If these arms happen by any chance to be broken off, they are soon afterwards reproduced. The animals are also furnished with a hard, strong and horny mouth, resembling, both in texture and substance, the beak of a parrot. With this they are enabled to break the shells of Limpets, and other shelled animals on which they feed. In the back, under the skin, is a kind of bone composed of thin parallel plates one above another, and separated by little columns arranged in quincunx order. This bone is oval, thick towards the middle and thin at the circumference. It is extremely light, and generally elastic, and in the living animal transparent like glass: the surface in some species is marked with longitudinal furrows. When dried and pulverized, the bone of the Officinal Cuttle-fish is employed by silversmiths for moulds, in which they cast their small work, as spoons, rings, &c. It is also converted into that useful article of stationary called pounce. This bone, on account of its lightness, is sometimes called sea-foam or sea-biscuit.

In the belly of the Cuttle-fish is a veſſel that contains a quantity of dark or inky fluid, which it emits, on contraction, when alarmed. This not only tinges the water so as to conceal its retreat, but is at the same time so bitter, as immediately to drive off its enemies.

Th' endanger'd Cuttle thus evades his fears,
And native hoards of fluid ſafely bears.
A pitchy ink peculiar glands ſupply,
Whoſe ſhades the ſharpeſt beam of light defy.
Purſu'd he bids the ſable fountains flow,
And wrapt in clouds eludes th' impending foe.
The fiſh retreats unſeen, while ſelf-born night
With pious ſhade befriends her parent's flight *.

Swammerdam was of opinion that the Indian ink is nothing more than this black fluid in an inspissated state, with the addition of perfumes. If Indian ink be dissolved in water in any considerable quantity, in the space of a few days it acquires a very high degree of putridity, clearly indicating its being formed of some animal substance; and no other seems so well calculated to compose it as this.

The male always accompanies the female, and when she is attacked will brave every danger, and attempt her rescue even at the hazard of his own life. As soon as she observes her partner to be wounded she immediately escapes, her timidity not suffering her to render him any assistance. When these animals are dragged out of the water, they make a noise somewhat like the grunting of a hog.

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* Jones's Oppian.

The young are produced from eggs deposited on the sea weed, in parcels exactly resembling a bunch of grapes. These are at first white, but after their impregnation by the male they become black: they are round, with a little point at the end, and in each of them is contained a Cuttle-fish surrounded by a gelatinous fluid.

*The Officinal Cuttle-fiſh** was in great esteem by the ancients as food, and it is even yet used as such by the Italians.

The Eight-armed Cuttle-fiſh † in the hot climates sometimes becomes of such a size as to measure twelve feet across its centre, and to have each of its arms between forty and fifty feet long. When the Indians go out in their canoes, in places frequented by these Sepia, they are always in dread of their flinging their arms over and sinking them; on which account they are careful to take with them an ax to cut them off.

THE STAR-FISH OR SEA-STAR.

THESE are inhabitants of the sea, and are usually found on the sand or among the rocks on the sea-shore considerably below high-water mark. Their covering is a coriaceous crust, which defends them from the attacks of the smaller animals; and they have five or more rays proceeding from a centre in which their mouth is situated. Every ray is furnished with a prodigious number of tentacula, or short soft and fleshy tubes, which appear to be of use not only in taking prey, and in aiding the motion of the animal, but also in enabling it to adhere to rocks and other substances, by which it withstands the force of the waves. In a single animal these tentacula have been found above 1500 in number: and when the Star-fiſh are thrown on their backs these may be observed to be pushed out and withdrawn in the same manner as snails do their horns. Their progressive motion, which is with their rays, is very slow: and by the undulation of these they are enabled to swim. They possess considerable powers of reproduction; for, if by any violence a ray is broken off, (for most of them are very brittle,) in the course of a short time they are provided with a new one. The mouth is armed with bony teeth, that are used in seizing and breaking the shells on which they feed: from hence a canal extends to each of the rays, runs through the whole length, and becomes gradually narrower as it approaches the extremity.

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* Sepia officinalis of Linnæus.

† Sepia octopodia of Linnæus.

If the Star-fish are drowned in brandy or spirits of wine, and the rays be kept flat and expanded during the time, it is easy afterwards to extract, by means of a pair of forceps, the stomach and intestines entire, through the mouth. This information may be of use to those who wish to preserve specimens of them, and were not previously possessed of it.

THE ARBORESCENT STAR-FISH*.

This extremely singular species is occasionally found in most seas, but never in any great number. It has five equi-distant, thickly jointed processes proceeding from its centre, each of which is divided into two other smaller ones, and each of these into two others still smaller; and this mode of regular subdivision is continued to a vast extent, and in the most beautiful gradation of minuteness, till at length the number of extreme ramifications sometimes amount to several thousands. One specimen, that measured three feet across, had five hundred and twelve extremities to each ray; so that, in this, the whole number was 2560. By this most curious structure the animal becomes as it were a living net, and is capable of catching such creatures as are by nature destined for its prey, by the sudden contraction of its innumerable ramifications; and the unfortunate object is secured by these beyond all possibility of escape†.

In order to preserve this curious animal whole and undamaged for cabinets, it should be taken far out in the sea; and the fishermen ought to be careful not

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[*] SYNONYMS.—Asterias Medusæ. *Linn.*—Magellanic Star-fish. Basket-fish. Branched Asterias. Medusa Star-fish.

[†] Shaw's Nat. Mis. vol. iii. tab. 103.

to break off any of the limbs, and to prevent the animal from contracting and entangling its outer and most slender branches. The fishermen of the Cape get six and sometimes even ten rix-dollars for one of these Star-fish.

When it is alive, or but just dead, its colour is a reddish or deep carnation; but on being dried it becomes somewhat grey. It should be dried in the shade, in some open place, where the wind has free access to it; for in the sun it is apt to dissolve, and if placed too much in the shade it frequently becomes putrid*.

THE SEA-URCHINS†.

The Sea-urchins are generally round, and shaped like a somewhat flattened ball. Their exterior is a bony crust, usually furnished with moveable spines, by which they are defended from injury, and by means of which they have their progressive motion: these are often very numerous, amounting in some species to upwards of two thousand. The mouth is placed beneath, and in most of the species has five valves or teeth.

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* Thunberg, i. 240. † Sea Hedge-hogs or Sea-Eggs.

They are all inhabitants of the sea, and in their general character have so great an alliance to each other, that it will not be necessary to bring forward more than one species to illustrate the whole genus.

THE COMMON SEA-URCHIN*.

This animal, which lodges in cavities of rocks just within low-water mark, on most of the British coasts, is nearly of a globular shape, having its shell marked into ten partitions or divisions, not much unlike those of an orange. The mouth is situated in the lower or under part, and armed with five strong and sharpened teeth. The stomach and intestines, which are of considerable length, are disposed in a somewhat circular form; and the whole body is supported entirely by a set of upright bones or columns. On the outside of the shell is a prodigious number of sharp moveable spines, of a dull violet and greenish colour, curiously articulated, like ball or socket, with tubercles on the surface, and connected by strong ligaments to the skin or epidermis with which the shell is covered. The spines are the instruments by which the animal conveys itself at pleaſure from one place to another; and by means of these it is enabled to move at the bottom of the water with great swiftness. It generally employs those about the mouth for this purpose, keeping that opening downwards; but it is also asserted to have the power of moving forward by turning on itself like a wheel. When any thing alarms these animals, they immediately move all their spines towards it, and wait an attack, as an army of pikemen would with their weapons. The number of muscles, fibres, and other apparatus necessary to the proper management of these must be very great, and are exceedingly wonderful.—So tenacious are the Sea-urchins of the vital principle, that, on opening one of them, it is no uncommon circumstance to observe the several parts of the broken shell move off in different directions.

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* SYNONYMS.—Echinus esculentus. *Linn.*—Eatable Echinus. *Penn.*—Common Echinus, or Esculent Echinus.——*Shaw's Nat. Mis.*

Between the spines, and disposed in a continued longitudinal series on the ſeveral divisions or regions of the shell, are an infinite number of very small foramina, communicating with an equal number of tentacula placed above them. These are the instruments by which the creature affixes itself to any object, and stops its motion. They are possessed of a very high degree of contractile power, and are furnished at the extremities with an expansile part, which may be supposed to operate as a sphincter, or as the tail of a leech, in fastening the animals securely to rocks and other substances to which they chuse to adhere.

The shell of this animal, when deprived of the spines, which easily fall off in dying, is of a pale reddish tinge, and the tubercles on which the spines are fixed, appear like so many pearly protuberances on the surface.

At Marſeilles and in some other towns on the Continent, this species is exposed for sale in the markets as oysters are with us, and is eaten boiled like an egg. It forms an article of food among the lower class on the sea-coasts of many parts of this country, but does not seem to have made its way to the tables of the opulent. The Romans adopted it, and dressed it with vinegar, mead, parsley, and mint*.

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* Shaw's Nat. Mis. vii. tab. 223.—Barbut's Gen. Verm. p. 90.—Sloane, ii. 267.—Penn. Brit. Zool. iv. p. 68.

THE BERNACLES[*].

THESE shells are fixed at the base, and consist of more than two unequal and erect valves. The animal that inhabits them is similar to one inhabiting submarine rocks, that Linnæus has placed in the last order under the name of *Triton*.

The two shells of this tribe that are best known are the *Common Bernacle* [†], which is found adhering in vast numbers to rocks, oysters and other shell-fish, and the *Goose-Bernacle* [‡], so well known from the fables of its producing the Bernacle Goose.

The animals contained in these shells, as well as in those of all the other species, have twenty-four claws or tentacula, all joined in pairs near the bottom, and inserted in one common base. The twelve longest stand somewhat erect and arched, arising from the back part of the animal; they appear like so many yellow curled feathers, clear, horny, and articulated: every joint is furnished with two rows of hairs on the concave side. They are of use in catching prey, and the animals are continually extending and contracting these arched hairy claws, which serve as a net.

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[*] The Linnean order of TESTACEOUS or SHELL-FISH commences here.

[†] Lepas Balanus of Linnæus.

[‡] Lepas anatifera of Linnæus.

The twelve smallest are placed, six on each side, in the front of these. They are more pliable and fuller of hairs than the others, and seem to perform the office of hands.

The trunk or proboscis rises from the middle of the base of the larger claws, and is longer than any of them. This the animal moves with great agility in any direction: it is tubular, transparent, and composed of rings lessening gradually to the extremity, where it is surrounded with a circle of small bristles, which are likewise moveable. Along the inside of this transparent proboscis appears the spiral dark-coloured tongue, which is extended and contracted at pleasure.

The mouth, formed not unlike a contracted purse, is placed in front between the smaller claws, within the folds of which are six or eight horny laminæ or erect teeth. Under this lie the stomach, intestines, and tendons by which the animal adheres to the shell *.

The Goose Bernacles consist each of five shells. They adhere in clusters to the bottoms of vessels and old timber, by means of tubes that in appearance are like some of the Corallines †.

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* Ellis on Bernacles, Phil. Tran. vol. l. p. 845.

† See the account of the Bernacle Goose, in vol. ii.

THE PHOLAS TRIBE.

The Pholas has a shell of two valves that open wide at each end, with several lesser ones at the hinge. The hinges are folded back, and united by a cartilage; and in the inside, beneath the hinge, is an incurved tooth. The animal contained in this shell is called an *Ascidia*.

The animals of this tribe perforate clay, spongy stones and wood, while very young; and as they increase in size they enlarge their habitation within, and thus become imprisoned. They are always found below high water mark, and a mass of rock may sometimes be seen wholly perforated by them. They have two orifices or openings capable of elongation in the manner of a proboscis: one of these is supposed to be the mouth, and has the faculty of spouting water as from a fountain. Most of them contain a phosphorescent liquor, of great brilliancy in the dark, which also illuminates whatever it touches or happens to fall upon.

From the following species the character of nearly the whole genus may be collected.

THE DACTYLE PHOLAS*.

This is an oblong shell, marked with somewhat spinous stripes. When full grown it is about an inch and a quarter long, and near five inches broad.

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* Pholas dactylus. *Linn.*

It is of a whitish colour, and in external appearance has some resemblance to a muscle.

The great powers of penetration of these animals compared with their apparent imbecility have justly excited the astonishment of philosophers and naturalists in all ages. When divested of their shell they are roundish and soft, with no instrument that seems in the least fitted for boring into stones, which they are known to do, or even for penetrating the softest substance. They are, indeed, each of them furnished with two teeth; but these are placed in such a situation as to be incapable of touching the hollow surface of their stony dwellings. They have also two corners to their shells, that open and shut at either end; but these are totally unserviceable to them as miners. The instrument with which they perform all their operations, and by means of which they bury themselves in the hardest rocks, is only a broad fleshy substance, somewhat resembling a tongue, that is seen issuing from the bottom of the shell. With this soft yielding instrument, while yet young and small, they work their way into the substance of the stone, and they enlarge their apartment as their increasing size renders it necessary.

The seeming unfitness, however, of this animal for penetrating into rocks, and there forming an habitation, has induced many philosophers to suppose that they entered the rock while it was yet in a soft state, and, from the petrifying quality of the water, that the whole rock afterwards hardened round them by degrees. This opinion, however, has been confuted, in a very satisfactory manner, by Dr. Bohads, who observed that many of the pillars of the temple of Serapis at Puteoli were penetrated by these animals. Whence he justly concludes, that the Pholades must have pierced into them after they were erected; for no workman would have laboured a pillar into form, if it had been honey-combed by worms in the quarry. In short, there can be no doubt but that the pillars were perfectly sound when erected, and that these animals attacked them during the time in which they continued buried under water, from the earthquake that swallowed up the city.

From hence it appears that, in all nature, there is not a greater instance of perseverance and patience than what this animal is seen to exhibit. Furnished with the bluntest and softest augre, by slow, successive applications, it effects what other animals are incapable of performing by force, penetrating the hardest bodies only with its tongue. When, while yet very small, it has effected an entrance, and buried its body in the stone, it there continues for life at its ease; the sea-water that enters at the little aperture supplying it with luxurious plenty. Upon this seemingly thin diet it by degrees grows larger and larger, and soon finds itself under the necessity of increasing the dimensions of its habitation and its shell.

The motion of the Pholas is slow beyond conception; its progress keeps pace with the growth of its body; and in proportion as it becomes larger it makes its way farther into the rock. When it has got a certain way in, it then turns from its former direction and hollows downward; till, at last, when its habitation is completed, the whole apartment resembles the bowl of a tobacco pipe; the hole in the shank being that by which the animal entered.

Thus immured, the Pholas lives in darkness, indolence, and plenty; it never removes from the narrow mansion into which it has penetrated; and seems perfectly content with being inclosed in its own sepulchre. The influx of the sea-water that enters by its little gallery, satisfies all its wants; and without any other food it is found to grow from five to eight inches long, and thick in proportion.

Yet the Pholas thus shut up is not so solitary an animal as would at first appear; for though it is immured in its hole, without egress, though it is impossible for the animal, grown to a great size, to get out by the way it made to get in, yet many of this kind often meet in the heart of the rock, and, like miners in a siege, who sometimes cross each other's galleries, they frequently break in upon each other's retreats. They are commonly found in great numbers in the same rock, and sometimes above twenty are discovered within a few inches of each other.

This animal is found in the greatest quantity at Ancona, in Italy; it is found also along the shores of Normandy and Poitou, in France, and upon some of the coasts of Scotland. It is in general considered as a very great delicacy at the tables of the luxurious*.

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* Goldsmith.

THE RAZOR-SHELLS*.

THESE shells are bivalve, oblong, in shape somewhat resembling the handle of a razor, and open at both ends: the hinge has a small and sharp reflected tooth, sometimes double, not inserted into the opposite valve. The animal is similar to that of the last genus.

Many of the bivalved shell-fishes have the power of performing a progressive or retrograde motion by an instrument that has no small resemblance to a leg or foot, and called the tongue. But the present animals can, at pleasure, make this assume almost every kind of form, according as their exigencies require. By this tongue they are not only enabled to creep, to sink into the mud, or disengage themselves from it, but to perform a motion which no one could suppose shell-fishes were capable of performing.

All the species of Razor-shells are incapable of progressive motion on the surface; but they dig a hole or cell in the sand, sometimes two feet in depth, in which they can ascend or descend at pleasure. The instrument or tongue, by which they perform all their motions, is situated at the centre. It is fleshy, cylindrical, and pretty long. When necessary, the animals can make the termination of the tongue assume the form of a ball. The Razor-fish, when lying on the surface of the sand, and about to sink into it, extends its tongue from the inferior end of the shell, and makes the extremity of it take the form of a shovel, sharp on each side, and terminating in a point. With this instrument the animal cuts a hole in the sand. After the hole is made, it advances the tongue still farther into the sand, makes it assume the form of a hook, and with this hook, as a fulcrum, it obliges the shell to descend into the hole. In this manner the animal operates till the shell totally disappears. When it chuses to regain the surface, it puts the termination of the tongue into the shape of a ball, and makes an effort to extend the whole tongue: but the ball prevents any farther descent, and the muscular effort necessarily pushes the shell upward till it reaches the surface, or top of the hole. It is amazing with what dexterity and quickness these seemingly awkward motions are performed.

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* Solen. *Linn.*

It is remarkable that the razor-fish, though it lives in salt water, abhors salt. When a little salt is thrown into the hole, the animal instantly quits his habitation. But it is still more remarkable, that, if the animal is once seized with the hand, and afterwards allowed to retire into its cell, salt will then be strewed in vain, for the fish will never again make its appearance. If it is not handled, by applying salt the animal may be made to come to the surface as often as a person pleases; and fishermen often make use of this stratagem. This conduct indicates more sentiment and recollection than one would have been inclined to expect from an animal so low in the order of nature as a Razor-fish.

THE OYSTER TRIBE.

The Oysters are bivalve shell-fish, with the valves generally unequal. The hinge is without teeth, but furnished with an ovate hollow, and mostly with lateral transverse grooves.

THE EDIBLE OYSTER *.

These Oysters inhabit the European and Indian seas, and are well known as a palatable and nutritious food. Most of our coasts produce them in great abundance, but the coasts chiefly celebrated are those of Essex and Suffolk. Here they are dredged up by means of a net with an iron scraper at the mouth, that is dragged by a rope from a boat, over the beds. As soon as taken from their native beds they are stored in pits formed for the purpose, furnished with sluices, through which, at the spring tides, the water is suffered to flow. This water being stagnant, soon becomes green in warm weather, and in a few days afterwards the Oysters acquire the same tinge, which renders them of greater value in the market: but they do not acquire their full qua-

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* Ostrea edulis. *Linn.*

lity, and become fit for sale, till the end of six or eight weeks.

The principal breeding-time of Oysters is in April and May, when they cast their spawn, or *spats*, as the fishermen call them, upon rocks, stones, shells, or any other hard substance that happens to be near the place where they lie, to which the spats immediately adhere. These till they obtain their film or crust are somewhat like a drop of a candle, but are of a greenish hue. The substances to which they adhere, of whatever nature, are called *cultch*. From the spawning-time till about the end of July the Oysters are said to be sick, but by the end of August they become perfectly recovered. During these months they are out of season, and are bad eating. This is known, on inspection, by the male having a black, and the female a milky substance in the gill.

The Oyster fishery of our principal coasts is regulated by a court of admiralty. In the month of May the fishermen are allowed to take the Oysters in order to separate the spawn from the cultch, the latter of which is thrown in again to preserve the bed for the future. After this month it is felony to carry away the cultch, and otherwise punishable to take any Oyster, between whose shells, when closed, a shilling will rattle. The reason of the heavy penalty on destroying the cultch, is, that when this is taken away, the ouse will increase, and muscles and cockles will breed on the bed and destroy the Oysters, from their gradually occupying all the places on which the spawn should be cast. There is likewise some penalty for not treading on and killing, or throwing on shore any Star-fish * that are seen, which are very destructive to the Oysters, by inserting their rays between the shells, when they are open, and destroying the animals within.

Oysters are not reckoned proper for the table till they are about a year and half old; so that the brood of one spring are not to be taken for sale till at least the September twelve-months afterwards. When younger than these happen to be taken in the dredge, they are always thrown into the sea again. The fishermen know the age of Oysters by the broader distances or interstices among the rounds or rings of the convex shell.

The Oysters in the pits of course always lie loose, but on their native beds they are in general fixed (from the time they are cast) by their under shell; and their goodness is said to be materially affected by their being laid in the pits with the flat shell downwards, not being able in this position to retain sufficient water in the shell for their support †.

The French assert, but apparently without proof, that the English Oysters, which are esteemed the best in Europe, were originally procured from Concalle Bay near St. Malo.

With regard to the locomotive faculty of the

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* Asterias.

† Haak on the Breeding of Colchester Oysters, MSS. in Brit. Mus. Ays. Cat. No. 243. 49.—Tuke on the Generation and Ordering of Colchester Oysters, Sprat's History of the Royal Society, p. 307.

Oyster, when detached from its native rocks or habitation, (which is a subject of curious investigation,) every one must have observed that it cannot take place in the usual way of other vivalves, by means of a foot, for such an appendage is altogether wanting in it. The abbé Dicquemaire, who attended minutely to the manners of these as well as of several other marine animals, assures us that they have a power of moving themselves, and this by the singular effort of ejecting water with considerable force from their shells. They thus are able either to throw themselves backward, or to start aside in a lateral direction. He says, that any person may amuse himself with the squirting and motions of Oysters, by putting them in a plate placed in an horizontal position, which contains as much sea-water as is sufficient to cover them.

The Oyster has been represented by many authors as an animal destitute not only of motion, but of every species of sensation. The abbé Dicquemaire, however, has shown that it can perform movements perfectly consonant to its wants, to the dangers it apprehends, and to the enemies by which it is attacked. Instead of being destitute of sensation, Oysters are even capable of deriving some knowledge from experience. When removed from situations that are constantly covered with the sea, from want of experience, they open their shells, lose their water, and die in a few days. But, when taken from similar situations, and laid down in places from which the sea occasionally retires, they feel the effect of the sun's rays, or of the cold air, or perhaps apprehend the attacks of enemies, and accordingly learn to keep their shells close till the tide returns*.

The muscular power of this as well as of most other bivalved shell-fish, in closing the shells, is very great, and is always exerted on the least alarm. Mr. Borlase mentions an instance of three young mice having been found killed by an Oyster's closing its shell upon them while stealing in to devour him.—This gentleman was also informed by a clergyman of the utmost veracity, that the enemies of these animals have modes of destroying them, notwithstanding both their strength and cunning. As a friend of the latter was one day fishing in the sea, he observed a lobster make several attempts to get at an Oyster, but on his approach it always closed its shells. At length the lobster, having waited till it lay pretty wide open, contrived to push a stone betwixt the gaping shells, when he immediately sprung upon his prey and devoured it †.

Oysters breathe by means of gills: they draw the water in at their mouth, a small opening in the upper part of the body, drive it down a long canal that constitutes the base of the gills, and so out again, retaining the air for the necessary functions of the body. Thus their ejecting of water seems to serve the double purpose, of aiding the motion of such as are loose, and of supplying the animals with air.

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* Journal de Physique.

† Borlase's Nat. Hist. of Cornwall, p. 274.

THE SCALLOP *.

The Scallop has the power of progressive motion upon land, and likewise of swimming on the surface of the water. When this animal happens to be deserted by the tide, it opens its shell to the full extent, then shuts it with a sudden jerk, by which it often rises five or six inches from the ground. In this manner it tumbles forward till it regains the water. When the sea is calm, troops or little fleets of Scallops are often observed swimming on the surface. They raise one valve of their shell above the surface, which becomes a kind of sail, while the other remains under the water, and answers the purpose of a keel, by steadying the animal, and thus preventing its being overset. When an enemy approaches, they instantly shut their shells, plunge to the bottom, and the whole fleet disappears. By what means they are enabled to regain the surface, we are still ignorant.

THE MUSCLES.

The Muscle tribe is distinguished by the shell being bivalve, without any tooth in the hinge, but

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* Ostrea maxima. *Linn.*——Pecten maximus. Great Scallop. *Penn.*

in having the hinge marked with a longitudinal hollow line; and by the animal's being generally fixed to some substance by a byssus or silky beard.

THE EDIBLE MUSCLE *.

This species is found adhering to rocks both in the European and Indian seas, but growing to a much greater size between the Tropics than northwards.

All the muscles have, for an instrument of motion, a tongue or foot capable of considerable elongation, and also of being shortened into the form of a heart. This is marked with a longitudinal furrow, and completely enveloped in a sheath formed of transverse and circular fibres of an obscure purple colour. When the animal feels inclined to change its place it thrusts the foot out of the shell, and raises itself on its edge; then, by reaching this to as great a distance as it will extend, it uses it as a kind of arm, drawing the body up to it, and thus it proceeds till it has found a convenient situation. If the muscle is inclined to make this its residence, the instrument of its motion is now put to a very different employment, in spinning those silky threads that fix it firmly to the spot, and, like a ship at anchor, enable it to brave all the agitations of the water. This it accomplishes by seizing with its point the gluten supplied by a gland situated under its base, and drawing it out, through the furrow, into threads. When the muscle is thus fixed it lives upon the

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* Mytilus edulis. *Linn.*

little earthy particles, or upon the bodies of such smaller animals, as the water transports to its shells.

The present muscle is generally esteemed a rich and wholesome food; but to some constitutions it often occasions disorders, the symptoms of which are great swellings, eruptions of blotches or pimples, shortness of breath, convulsive motions, and sometimes even delirium. A remedy that has been recommended is two spoons-full of oil, and one of lemon juice, (or, in want of this, about two of vinegar,) shaken well together, and swallowed as soon as any of the symptoms take place. This unwholesome quality has been attributed to a small species of crab * that sometimes is found in the shells of the muscle: it seems however not to have its seat in any thing essential to the muscle; for it has often been observed, when accidents of this kind have happened, that some persons have been affected, and others have not who have eaten at the same time, and perhaps even in larger quantities.

THE PEARL MUSCLE †.

The Pearl Muscle has a flattened and nearly orbicular shell, about eight inches long, and somewhat more in breadth. The colour of the exterior is very various, being in some individuals sea-green, in others chesnut, or even bloom colour with white rays, and

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* Cancer Pisum of Linnæus.

† Mytilus margaritiferens. *Linn.*

sometimes whitish with green rays. The young shells resemble Scallops, having ears as long as the shell.

The Pearl is a calculus or morbid concretion, which is produced not only in this, but sometimes in the Common Oysters and Muscles; but in these it is generally very small, and of little value. It is found both in the body of the animal, and in the shells on the outside of the body.

The principal fishery for pearls is on the coast of Tinevelly in Eastern Hindostan, where the natives find it of such commercial importance, as to employ in it several hundreds of small vessels. The pearls are taken at two seasons of the year, in March and April, and again in August and September. They do not however fish every year; for if, upon trial, they do not find the pearls sufficiently valuable, they abstain till the ensuing season to allow them time to increase their size.

A cord is fastened under the arms of the divers, and held by the persons in the boat; and to accelerate their descent, the divers have a perforated stone of eighteen or twenty pounds weight tied with a cord to their great toe. Each of them is also furnished with a sack, that has the mouth distended by a hoop. They then descend, and, on reaching the bottom, slip off the stone, which is drawn up, and fill their sack with shells. When this is full they give a signal by pulling the rope, and they are then drawn up by the men in the boats.

The depth of the water is twenty or thirty yards, and the distance from shore four or five leagues.

When drawn up they rest eight or ten minutes, to recover their breath, and then plunge in again; and a succession of them continue this slavish employment for ten or twelve hours every day. The shells are left in vast heaps to putrefy till the season is over. The gains of the adventurers are often small, as the success is very precarious. Great pearls are but seldom taken, and the generality of what are taken are of the smaller kind, called Seed Pearls, which are sold by the ounce to be converted into powder.

The *shells* are found adhering to the coral banks. Numbers of sharks lurk about the diving-places, which often devour the poor adventurers[*].

THE ARGONAUTS.

In this tribe the shell is univalve, spiral, involute, and membranaceous, with only a single cell.

THE PAPER NAUTILUS[†],

which is six or eight inches in length, and but little either thicker or stronger than paper, is found in the Mediterranean Sea, and in the Indian Ocean. It is the famous *Nautilus* of the ancients, and is supposed, in the early ages of society, to have furnished the original idea of navigation:

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[*] Penn. Outl. ii. p. 2.

[†] Argonauta Argo. *Linn.*

Learn of the little Nautilus to sail,
Spread the thin oar, and catch the driving gale.

When it means to sail, it discharges a quantity of water from its shell, by which it is rendered lighter than the surrounding medium, and of course rises to the surface : here it extends two of its arms upwards, which are each furnished at their extremity with an oval membrane that serves as a sail. The other six arms hang over the sides of the shell, and supply the place either of oars or rudder. The inhabitant of the shell, if seen detached, might be mistaken for a Sepia, bearing so great a resemblance to the *Sepia Octopodia*, or Eight-armed Cuttle-fish, that its principal difference consists only in the shape of the arms that are used as sails.

In some places, when the sea is not agitated by winds, great numbers of these singular creatures may sometimes be seen diverting themselves by sailing about in this manner; but as soon as a storm rises, or any thing gives them disturbance, they retract their arms, take in as much water as renders them ſomewhat heavier than that in which they swim, and then sink to the bottom. Several of them were observed by M. Le Vaillant on the sea near the Cape of Good Hope; and as he was desirous of obtaining perfect specimens of the shells, he sent some of his people into the water to catch them: but when the men had got their hands within a certain distance, they always instantly sank, and, with all the art that could be employed, they were not able to lay hold of a single one. The instinct of the animal showed itself superior to all their subtilty; and when their disappointed master called them away from their attempts, they expressed themselves not a little chagrined at being out-witted by a shell-fish *.

This species, which is the real Nautilus, is not to be confounded with the Chambered or Pearly Nautilus, which belongs to a different tribe, and bears very little resemblance to the present either in its construction or habits.

SNAILS.

The Snails have a spiral and somewhat pellucid shell, the aperture of which is roundish. Their bodies, in general construction, are similar to those of the Slugs.

The wise Author of nature has denied to these animals the use of feet and claws to enable them to move from place to place, but he has made them ample amends in a way more commodious to their habits and mode of life, by the broad skin along each side of the belly, and the power of motion that this possesses. By this motion they are enabled to creep, and by the skin, assisted with the glutinous slime emitted from their body, they adhere firmly and securely even to the smoothest surfaces.

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* Le Vaillant's New Travels, i. 129.

When the Snail is in motion, four horns are distinctly seen proceeding from its head; but the two uppermost and longest of these deserve peculiar consideration, both on account of the various motions with which they are endued, and also from their having eyes fixed at the extreme ends of them. These appear like two blackish points, and when taken from the body are of a bulbous figure: they have but one coat; and the vitreous, the aqueous, and the crystalline humours are (though not very distinctly) to be seen. These eyes the animal can direct to different objects at pleasure, by a regular motion out of the body; and sometimes it hides them, by a very swift contraction into the belly. Under the smaller horns is the animal's mouth; and though its substance may appear too soft to be furnished with teeth, yet it has no fewer than eight: with these it chews leaves and other substances, seemingly harder than any part of its own body; and with these it even sometimes bites off pieces of its own shell.

The snail, when its shell is broken, possesses the power of mending it. Sometimes the animals are seemingly crushed to pieces; and, to all appearance, utterly destroyed: yet still they set themselves to work, and with the slimy substance that they force from their bodies, which soon hardens, they in a few days mend all their numerous breaches. All the junctures are, however, very easily seen; for these have a fresher colour than the rest, and the whole shell in some measure resembles an old coat patched with new pieces. They are sometimes seen with eight or ten of these patches. Still, however, though the animal is possessed of the power of mending its shell, it cannot, when come to its full growth, make a new one. Swammerdam tried the experiment: he stripped a snail of its shell, without injuring any of the blood-vessels, retaining that part of the shell where the muscles were inserted: but it died in three days after it lost its covering; not, however, without making efforts to build up a new shell; for, before its death, it pressed out a certain membrane round the whole surface of its body. This membrane was entirely of the shelly nature; and was intended, no doubt, as a supply towards a new one.

The following instances of tenacity of life in snails are well authenticated, and probably without parallel in any other division of the animal creation.

Mr. Stuckey Simon, a merchant of Dublin, whose father, a fellow of the Royal Society, and a lover of natural history, left to him a small collection of fossils and other curiosities, had amongst them the shells of some snails. About *fifteen years* after his father's death (in whose possession they were many years) he by chance gave to his son, a child about ten years old, some of these snail-shells to play with. The boy put them into a flower-flot, which he filled with water, and the next day into a basin. Having occasion to use this, Mr. S. observed that the animals had come out of their shells. He examined the child, who assured him that they were the same he had given him, and said he had also a few more, which he brought. Mr. S. put one of these into water, and in an hour and a half after observed that it had put out its horns and body, which it moved but slowly, probably from weakness. Major Vallancy and Dr. Span were afterwards present, and saw one of the snails crawl out, the others being dead, most probably from their having remained some days in the water. Dr. Quin and Dr. Rutty also examined the living snail several different times, and were greatly pleased to see him come out of his solitary habitation after his so many years confinement. Dr. Macbride, and a party of gentlemen at his house, were also witnesses of this surprising phænomenon. Dr. Macbride has thus mentioned the circumstance: "After the shell had lain about ten minutes in a glass of water that had the cold barely taken off, the snail began to appear; and in five minutes more we perceived half the body pushed out from the cavity of the shell. We then removed it into a basin, that the snail might have more scope than it had in the glass; and here, in a very short time, we saw it get above the surface of the water, and crawl up towards the edge of the basin. While it was thus moving about, with its horns erect, a fly chanced to be hovering near, and, perceiving the snail, darted down upon it. The little animal instantly withdrew itself into the shell, but as quickly came forth again when it found the enemy was gone off. We allowed it to wander about the basin for upwards of an hour, when we returned it into a wide-mouthed phial, wherein Mr. Simon had lately been used to keep it. He was so obliging as to present me with this remarkable shell; and I observed, at twelve o'clock, as I was going to bed, that the snail was still in motion, but next morning I found it in a torpid state, sticking to the side of the glass."

A few weeks afterwards this shell was sent to sir John Pringle, who shewed it at a meeting of the Royal Society; but some of the members imagining that Mr. Simon must have been imposed upon by his son having substituted fresh shells for those that had been given to him, the boy was re-examined by Dr. Macbride on the subject, who declared that he could find no reason to believe that the child either did or could impose upon his father. Mr. Simon's living in the heart of the city rendered it almost impossible for the boy (if he had been so disposed) to collect fresh shells, being at that time confined to the house with a cold. Mr. Simon has also declared that he is positive those were the shells he gave to him, having in his cabinet many more of the same sort, and nearly of the same size*.

In consequence of the account, from which the above was extracted, appearing in some periodical publication, the following letter, bearing every mark of authenticity, was sent by a Mr. Rowe to the editors of the Annual Register; he states it to have been written by a lady, but her name he was not at liberty to mention.

" There is in the last magazine, an account of the reviving of some snails which had lain in Mr. Simon's cabinet fifteen years. Is it not a most extraordinary story? And yet I am not faithless in that point, as many a reader probably is; for I once saw a very remarkable property in snails, which gave me such uneasiness as fixed the remembrance strongly in my mind to this minute, though it happened many years ago.

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* Philosophical Transactions.

"I was at Wrotham, at Mr. Haddock's in Kent, and was making a little shell-work tower, to stand on a cabinet in a long gallery. After having repaired two small amber temples to grace the corners, I was desirous of having some odd pretty ornament in front; and sea-shells running short before I had finished, I recollected having seen some pretty little snails on the chalk-hills there; and we all went one evening to pick up some, and found variety of forms, and colours, and sizes. We returned home weary enough, and longed for tea, though itwas latish; and a large boiler was brought in, as we were a round company. I was contriving how to kill the snails in the easiest and most merciful manner, when a wag said, 'Stick them on alive;' at which I shuddered, and called him brute. At length I got a large china basin and, putting a handful or two of snails into it, I filled it up with boiling water; and though my heart recoiled at the deed, yet my eagerness to finish my work next morning conquered my compassion. To make sure of giving my snails the *coup-de-grace*, I poured off the first water, and then filled the bowl again with more out of the hot boiling kettle. I carried the basin into a summer-house in the garden, where I loved to go to work early in a morning, before my friends were stirring, and the next morning I arose sooner than common, and went into the summer-house: but how great was my surprise to find my poor snails crawling about, some on the edge of the basin, some tumbling over, some on the table, and one or two actually eating the paste that was to stick them on! I was perfectly shocked, and burst into tears; and, picking up every snail carefully, carried them into a field beyond the garden, where I make no doubt but they perfectly recovered their scaldings in boiling water.

"I had an abundance of empty shells of the same kinds, but they had not the beauty of those which had snails in them. However, I used those only which I could apply without cruelty and compunction.

"This I thought then a very surprising event; but Mr. Simon's snails I must confess are far superior to mine *."

From various experiments that have been made on Snails, it appears that they are possessed of considerable powers of reproduction. Spallanzani found that the whole head might be cut off, and that in a certain time another would be formed.

THE GARDEN SNAIL †.

See to the fight the gentle warriors move,
And dart, with harmless force, the shafts of love!

The mode of breeding, in this and a few other species of Snails, is extremely curious, and too well

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* Ann. Reg. vol. xvii. p. 86.

† Helix hortensis, *Linn.*

authenticated to be doubted. At a certain time of the year they meet in pairs, and, stationing themselves an inch or two apart, lanch several little darts, not quite half an inch long, at each other. These are of a horny substance, and sharply pointed at one end. The animals, during the breeding season, are provided with a little reservoir for them, situated within the neck, and opening on the right side. On the discharge of the first dart, the wounded Snail immediately retaliates on its aggressor by ejecting at it a similar one: the other again renews the battle, and in turn is again wounded. Thus are the darts of Cupid, metaphorical with all the rest of the creation, here completely realized in Snails. After the combat they come together. Each of them lays its eggs in some sheltered and moist situation, generally under a little clod of earth, or in some cool cavity. The eggs are about the size of small peas, semi-transparent and of a soft substance. From these the young are hatched completely formed, with shells on their backs; and they undergo no further change than what necessarily takes place in the gradual increase of their size.

The depredations that these animals commit in gardens and orchards is very considerable; and it is remarkable that in defect of moist and succulent food, as fruit and tender leaves, they will even attack substances of a dry and hard nature. The common Garden Snail has been known, when confined for single night under a glass of more than four hes in diameter placed on a sheet of common blue paper, entirely to devour the whole paper contained in the included space, to the very edge of the glass, so that a circular piece seemed almost as neatly taken out as if it had been marked by a pair of compasses*.

THE ESCULENT SNAIL†.

This is the largest of all the Land Snails produced in this country. It is found in the woods and under the hedges of Northamptonshire and some others of the southern counties.

At the commencement of winter it carefully closes up its shell with a thick white cover, or operculum, attached to its body, that just fills up the opening, and in this inclosed state remains till the commencement of warm weather, seldom appearing abroad till about the beginning of April.

It is large and fleshy, and, when properly cooked, not unpleasant to the taste. Among the Romans it constituted a favourite dish; but if the account of Varro is to be credited, they had it of a size infinitely larger than any now known, for this writer assures us that the shells of some of them would hold ten quarts. They kept these animals in what were called the Cochlearia or Snail Stews. These were generally made under rocks or eminences, whose bottoms were watered by lakes or rivers; and if a natural dew or moisture was not found, they formed an artificial one by bringing a pipe into the place bored full of holes like a watering-pot, through which it was continually sprinkled. They required little attendance or food, supplying themselves, in a great measure, as they crawled about the sides or floor of their habitation. To fatten them, however, they were fed with bran and sodden lees of wine*.

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* Shaw's Nat. Mis. i. tab. 30.

† Helix pomatia. *Linn.*

They are even yet much admired in some parts of the Continent, and not always used from economical motives, for at Vienna but a few years ago, seven of them were charged the same at an inn as a plate of veal or beef. The usual modes of preparing them for the table are either boiling, frying them in butter, or sometimes stuffing them with farse meat: but in what manner soever they are dressed, their sliminess always in a great measure remains. The greatest quantities and the finest Snails are brought from Suabia. Dr. Browne, who travelled to Vienna above a century ago, remarks, that since the markets were so well supplied with other provisions, "he was surprised to meet "with some odd dishes at their tables, as Guinea-"pigs, and divers sorts of Snails and Tortoises."

Dr. Townson was shewn at Erlau a snailery, which the proprietor informed him was constructed on an improved plan. In our island, he says, this might have had the denomination of a *Patent Snailery*, or *Philosophical Snail-sty*. It consisted only of a large hole, two or three feet deep, dug in the ground, with a wooden house as a cover.

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* Da Costa, p. 67.

The animals in this place were fed with the refuse of the garden thrown into them*.

There seems some doubt as to the original introduction of these snails into England: Pennant says it was by sir Kenelm Digby; and Da Costa, that a Charles Howard, esq. of the Arundel family, brought some of them, in the last century, from Italy, in the hopes of rendering them an article of food in this country, and for this purpose dispersed them about the woods and downs of Albury, an ancient seat of that family near Boxhill in Surrey. They are now to be found in considerable plenty, not only there, but even in parts of the confines of Sussex.

THE SHIP-WORM †.

This destructive animal is in general, when full grown, from four to six inches in length, of a grey colour, and about the thickness of the middle finger. It is covered with a very thin cylindrical and smooth shell; and has two calcareous hemispherical jaws, flat before, and angular behind.

Great numbers of these worms, which are supposed to have been introduced from India into Europe, are sometimes found in the sides and bottoms of ships; so much so indeed as often to endanger them. It is said that our vessels never suffered from these enemies till about fifty years ago, and that we imported them from the sea about the Antilles.

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* Townson's Travels, p. 15 and 222.

† Teredo navalis. *Linn.*

By means of their hard and cutting jaws they are able to bore a passage into any timber except such as is of an extremely hard and compact grain. They feed on the wood; and some writers, though apparently without foundation, say that they always bore in the direction of the grain, and that they cannot pass obliquely; and thence that when they come to a knot in the wood, or two of them happen to meet together, they perish from want of food.

In the year 1730 the inhabitants of the United Provinces were under serious alarm concerning these worms, which had made dreadful depredations in the piles that support the banks of many parts of those coasts. One of the persons who had the care of the Dutch coasts at that time observed, to his astonishment, that some of the timbers were, in the course only of a few months, made so full of holes that they could be beaten in pieces with the least force.

The perforations, when the mud was scraped off, did not appear much larger than to admit a pin's head to be thrust into them. A very thin piece of whalebone being put into one of these would enter straight forward for three or four lines, and the hole then generally for some distance farther proceeded upward.

One of the piles being split lengthwise with a hatchet or wedge, was found full of passages or hollow cylindrical ducts, each of which contained a worm, inclosed in a kind of testaceous tube or covering of a white colour, which it exactly filled, but in such a manner as to be able to move with freedom. This tube was found straight or bent, according to the form of that part of the hole where the animal was employed. The holes at the outer surface were very narrow, but increased in width within, evidently as the worm increased in size. They were never found to run into each other, but all to proceed separately *.

It was happily discovered a few years afterwards that these creatures had totally abandoned these coasts. It is said that they always die when brought into fresh water; and they never survive a long exposure to the air: in an hour their body will become apparently solid and much shrivelled up.

When professor Thunberg was in Japan, he observed the manner in which the Japanese contrived to preserve their vessels against the ravages of this destructive worm. This was simply to drag them on the strand, and burn the sides of them as high as the water usually reaches, till they were well covered with a coat of charcoal. This was considered an infallible remedy †.

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* Phil. Tran. vol. xli. p. 276. † Thunberg, iii. 147.

ZOOPHYTES *.

THE creatures that are ranked under this order seem to hold a middle station between animals and vegetables. Most of them, deprived altogether of loco-motion, are fixed by stems that take root in crevices of rocks, among sand, or in such other situations as nature has destined for their abode: these by degrees send off branches, till at length some of them attain the size and extent of large shrubs. The Zoophytes are usually considered under two divisions: the stony branches of the first, which has the general appellation of Coral, are hollow, and full of cells, the habitations of animals resembling Polypes, Medusæ, &c. according to their respective genera. They consist of the TUBIPORES, MADREPORES, MILLEPORES, and CELLEPORES; and are nearly all confined to the ocean. The animals appear at the ends of the branches, where they have somewhat the resemblance of animated blossoms endowed with considerable spontaneous motion. The stems of some of the Millepores are almost solid, the cells being so extremely small as to be scarcely visible without high magnifying powers. Among these is

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* This is the fourth of the Linnean orders of Worms.

the *Millepora Polymorpha*, or Officinal Coral of the shops.

The next division of the present order consists of such animals as have softer stems, and are in general not merely inhabitants of a stem or branches, but are themselves in the form of a plant. Those best known are the Corallines, the Sponges, and the Polypes.

The CORALLINES are composed of capillary tubes whose extremities pass through a calcareous crust, and open into pores on the surface. They are entirely submarine; and from their branches being finely divided and jointed, resembling some species of Lichen, they have, till late years, been arranged by botanists with the cryptogamious plants. In appearance they certainly approach very nearly to some of the vegetables; but their calcareous covering alone is sufficient demonstration of their being allied, in however humble a station, to a more elevated order of beings.

The SPONGES consist of an entirely ramified mass of capillary tubes, supposed by many to be the production of a species of worms which are often found straying about their cavities. This idea is now, however, nearly exploded. Others have imagined them mere vegetables. But that they are possessed of a living principle seems evident from the circumstance of their alternately contracting and dilating their pores, and shrinking in some degree from the touch whenever examined in their native waters. From their structure they are capable of absorbing nutriment from the fluid in which they are by nature immersed. They are the most torpid of all the Zoophytes. The species differ very greatly from each other both in shape and structure. Some are composed of reticulated fibres or masses of small spines: some, as the Common or Officinal Sponge, are of no regular shape, others are cup-shaped, others tubular, &c.

The *Officinal Sponge* is elastic, and very full of holes: it grows into irregular lobes of a woolly consistence, and generally adheres, by a very broad base, to the rocks. It is chiefly found about the islands in the Mediterranean, where it forms a considerable article of commerce. A variety of small marine animals pierce and gnaw into its irregular winding cavities. These appear on the outside, by large holes raised higher than the rest. When it is cut perpendicularly, the interior parts are seen to consist of small tubes, which divide into branches as they appear on the surface. These tubes, which are composed of reticulated fibres, extend themselves every way, by this means increasing the surface of the sponge, and ending at the outside in an infinite number of small circular holes, which are the proper mouths of the animal. Each of these holes is surrounded by a few erect pointed fibres, that appear as if woven in the form of little spines. These tubes, with their ramifications, in the living state of the sponge, are clothed with a gelatinous substance, properly called the flesh of the animal. When the sponge is first taken it has a strong fishy smell, and the fishermen take great care in washing it perfectly clean, in order to prevent its growing putrid.

The POLYPES* are gelatinous animals, consisting of a long tubular body, fixed at the base, and surrounded at the mouth by arms or tentacula. They are chiefly inhabitants of fresh waters, and are among the most wonderful productions of nature. The particulars of their life, their mode of propagation, and powers of reproduction, after being cut to pieces, are truly astonishing to a reflecting mind. Long after experiments had been made did scepticism involve the philosophic world; and the history of the animals did not obtain complete credit till these had not only been often repeated, but varied in every possible manner: they at length, however, incontestably proved the truth of the surprising and apparently impossible properties.

> See with new life the wondrous worm abound,
> Rich from its loss, and fruitful from its wound!

The *Green Polype*, a species that will fully illustrate the nature of the whole tribe, is found in clear waters, and may generally be seen in great plenty in small ditches and trenches of fields, especially in the months of April and May. It affixes itself to the under parts of leaves, and to the stalks of such vegetables as happen to grow immersed in the same water. The animal consists of a long, tubular body, the head of which is furnished with eight and sometimes ten long arms or tentacula that surround the mouth. It is capable of contracting its body in a very sudden manner when disturbed, so as to appear only like a roundish green spot; and when the danger is over it again extends itself as before.

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* Hydra of Linnæus.

It is of an extremely predacious nature, and feeds on the various species of small worms, and other water animals that happen to approach. When any animal of this kind passes near the Polype it suddenly catches it with its arms, and, dragging it to its mouth, swallows it by degrees, much in the same manner as a snake swallows a frog. Two of them may sometimes be seen in the act of seizing the same worm at different ends, and dragging it in opposite directions with great force. It often happens that while one is swallowing its respective end, the other is also employed in the same manner, and thus they continue swallowing each his part, until their mouths meet together; they then rest, each for some time in this situation, till the worm breaks between them, and each goes off with his share. But it often happens that a seemingly more dangerous combat ensues, when the mouths of both are thus joined together upon one common prey: the largest Polype then gapes and swallows his antagonist; but, what is most wonderful, the animal thus swallowed seems to be rather a gainer by the misfortune. After it has lain in the conqueror's body for about an hour, it issues unhurt, and often in possession of the prey that had been the original cause of contention. The remains of the animals on which the Polype feeds, are evacuated at the mouth, the only opening in the body. It is capable of swallowing a worm of thrice its own size: this circumstance, though it may appear incredible, is easily understood when we consider that the body of the Polype is extremely extensile, and is dilated on such occasions to a surprising degree.

The species are multiplied for the most part by vegetation, one or two, or even more young ones emerging gradually from the sides of the parent animal; and these young are frequently again prolific before they drop off: so that it is no uncommon thing to see two or three generations at once on the same Polype.

But the most astonishing particular respecting this animal is, that if the Polype is cut in pieces it is not destroyed, but is multiplied by its wounds: it is literally

> Rich from its loss, and fruitful from its wound.

It may be cut in every direction that fancy may suggest, and even into very minute divisions, and not only the parent stock will remain uninjured, but every section will become a perfect animal. Even when turned inside out it suffers no material injury; for, in this state, it will soon begin to take food, and to perform all its other natural functions.

Leuwenhoek was the first who discovered this animal, towards the end of the seventeenth century; but M. Trembley, of Geneva, made in the year 1740 the first experiments that proved decisively its properties. In the course of his experiments he found that different portions of one Polype could be engrafted on another. Two transverse sections brought into contact quickly unite, and form one animal, though each section belong to a different species. The head of one species may be engrafted on the body of another. When a Polypus is introduced by the tail into another's body, the two heads unite, and form one individual. Pursuing these strange operations, M. Trembley gave scope to his fancy, and, by repeatedly splitting the head and part of the body, formed hydras more complicated than ever struck the imagination of the most romantic fabulists.

These creatures continue active during the greatest part of the year, and it is only when the cold is most intense that they feel the general torpor of nature. All their faculties are then for two or thee months suspended; but if they abstain at one time they have ample amends in their voracity at another; and like all those animals that become torpid in winter, the meal of one day suffices them for months together.

ANIMALCULES *.

THESE animals are very simple in their form, and generally invisible without a magnifying power. They are chiefly found in infusions of animal and vegetable substances.

Their multiplication long occupied the attention and eluded the researches of philosophers: the discovery however, a few years back, that some of the larger animals increased by spontaneous division, gave rise to the conjecture that these microscopic animalcules might multiply their numbers in a similar manner. This conjecture was communicated to M. De Saussure in a letter from Bonnet, who received an answer from Genoa in September 1769, to the following purport:

" What you propose as a doubt (says M. de Saussure) I have verified by incontestable experiments, namely, that infusion animalcules multiply by continued divisions and subdivisions. Those roundish or oval animalcules that have no beak or hook on the fore-part of their bodies, divide transversely. A kind of stricture or strangulation begins about the middle of the body, which gradually increases, till the two parts adhere by a small thread only. Then both parts make repeated efforts, till

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* The Animalcules or Infusoria constitute the last of the Linnean Orders of Worms.

the division is completed. For some time after separation the two animals remain in a seemingly torpid state; but they afterwards begin to swim about briskly. Each part is only one half the size of the whole: but they soon acquire the magnitude peculiar to the species, and multiply by similar divisions. To obviate every doubt, I put a single animalcule into a drop of water, which split before my eyes. Next day I had five, the day after sixty, and on the third day their number was so great that it was impossible to count them.

"Another species, with a beak or horn on the fore-part of its body, which I obtained from an infusion of hemp-seed, multiplied likewise by division, but in a manner still more singular than the former. This animalcule, when about to divide, attaches itself to the bottom of the infusion, contracts its body, which is naturally oblong, into a spherical form, so that the beak entirely disappears. It then begins to move briskly round, sometimes from right to left, and sometimes from left to right, the centre of motion being always fixed. Towards the end, its motion accelerates, and, instead of an uniform sphere, two cross-like divisions begin to appear. Soon after, the creature is greatly agitated, and splits into four animalcules, perfectly similar to, though smaller than, that from which they were produced. These four increase to the usual size, and each in its turn subdivides into other four*."

The different kinds of animalcules are very numerous; on which account we shall confine our observations to a few of the most curious genera, namely Vorticella, Vibrio, and Volvox.

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* La Palingenesie Philosophique, par C. Bonnet, tom. i. p. 428.

Of these the VORTICELLA, or wheel animals, are the most remarkable both in their structure, their habits, and production. In general form they bear a great affinity to the polypes, having a contractile, naked body, furnished with rotatory organs round the mouth; and indeed many microscopical writers have denominated them cluster-polypes. They are very small, and generally found in clear stagnant waters, during the summer months, attached to the stalks of the lesser water plants, where they feed on animalcules still smaller than themselves. Many of the species are found in groupes, sometimes formed by the mere approximation of several individuals, and at other times by the ramified or aggregate manner in which they grow. Their various motions, like those of the polypes, are generally exerted only for the purpose of obtaining prey, the rotatory motion of their tentacula causing an eddy in the water around each individual sufficient to attract into its vortex such animalcules as happen to swim near: these the little creature seizes by suddenly contracting its tentacula and inclosing them in the midst. The stems of several of the species, into which they occasionally withdraw themselves, are somewhat rigid or scaly. The young are carried in oval integuments on the outside of the lower part of these; and, when ready to come forth, the parents aid their extrusion, where such is necessary, by writhing their bodies, or striking the little vesicle.

As soon as the young one is liberated from its prison, it fixes itself, and commences the necessary operations to procure its food.

The animals of the genus VIBRIO are very simple, round, and elongated worms, nearly all invisible to the naked eye. The species best known is the *Eel Vibrio*[*], which is found in sour paste, and in most sediments from an infusion of grain. Its body is pellucid, and tapers towards both ends. The general resemblance that it bears to an Eel has almost universally led microscopical writers to distinguish it by that title, though its most gigantic individuals are seldom a tenth of an inch in length. When paste becomes sour, if it is examined with a glass it will be seen to contain multitudes of these animalcules, moving about with great strength and rapidity in every direction. And animals very similar in appearance are also frequently to be observed in vinegar. They are viviparous, and produce, at intervals, a numerous progeny. If one of them is cut through the middle, several young ones, coiled up and inclosed each in a membrane, will be seen to issue from the wound. Upwards of a hundred young have been remarked to proceed from a single parent; which readily accounts for their sudden and prodigious increase. The *Proteus Vibrio* is a species that has its name from its very singular power of assuming different shapes so as sometimes with difficulty to be distinguished for the same animal. When water, in which any vegetable has been infused, or in which any animal substance is preserved, has stood undisturbed for some days, a slimy substance will be found on the sides of the vessel, some of which, if viewed in a microscope, will be found to contain, among several other animalcules, the Proteus. It is pellucid and gelatinous, and swims about, most commonly, with a long neck and bulbous body, with great vivacity. Sometimes it makes a stop for a minute or two, and stretches itself out apparently in search of prey. When alarmed it immediately draws in its neck, becomes more opake, and moves very sluggishly. It will then, perhaps, instead of its former long neck, push out a kind of wheel machinery, the motions of which draw a current of water, and, along with this, probably its prey. Withdrawing this, it will sometimes remain almost motionless for some seconds, as if weary; then protruding its long neck will often resume its former agility, or instead adopt in succession a multitude of different appearances. The eyes of this creature have not hitherto been discovered: it however swims with great rapidity among the multitudes of animalcules that inhabit the same water, without striking against them.

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[*] Vibrio anguillula of Linnæus.

We shall conclude our account of the Animal Creation with La Martiniere's description of *Volvox bulla*, a species of animals nearly the most simple of any that have yet come to our knowledge. "They consist (he says) only of oval bodies, similar in appearance to soap bubbles, arranged in parties of three, five, six and nine: among them are also some solitary ones. These collections of globules, being put into a glass filled with sea-water, described a rapid circle round the glass by a common movement, to which each individual contributed by the simple compression of the sides of its body, probably the effect of the reaction of the air with which they were filled. It is not, however, easy to conceive how these distinct animals (for they may be readily separated without deranging their economy) are capable of concurring in a common motion. These considerations, together with the form of the animal, recalled to my mind, with much satisfaction, the ingenious system of M. de Buffon ; and I endeavoured to persuade myself, that I was about to witness one of the most wonderful phenomena of nature, supposing that these molecules, which were now employed in increasing or diminishing their number, or performing their revolutions in the glass, would soon assume the form of a new animal, of which they were the living materials. My impatience led me to detach two from the most numerous group, imagining that this number might perhaps be more favourable to the expected metamorphosis. I was, however, mistaken. These I examined with more attention than the rest, and the following account is of their proceedings alone. Like two strong and active wrestlers, they immediately rushed together, and attacked each other on every side : sometimes one would dive, leaving its adversary at the surface of the water ; one would describe a circular movement, while the other remained at rest in the centre : their motions at length became so rapid as no longer to allow me to distinguish the one from the other. Having quitted them for a short time, on my return I round them reunited as before, and amicably moving round the edge of the glass by their common exertions.”

How wondrous is this scene! where all is form'd
With number, weight and measure! all design'd
For some great end! where not alone the plant
Of stately growth; the herb of glorious hue,
Or food-full substance; not the labouring steed,
The herd and flock that feed us; not the mine
That yields us stores for elegance and use;
The sea that loads our table, and conveys
The wanderer man from clime to clime, with all
Those rolling spheres, that from on high shed down
Their kindly influence; not these alone,
Which strike e'en eyes incurious, but each moss,
Each shell, each crawling insect, holds a rank
Important in the plan of Him, who fram'd
This scale of beings; holds a rank, which lost
Would break the chain, and leave behind a gap
That nature's self would rue.——Almighty Being,
Cause and support of all things, can I view
These objects of my wonder; can I feel
These fine sensations, and not think of thee?
Thou who dost through th' eternal round of time;
Dost through th' immensity of space exist
Alone, shalt thou alone excluded be
From this thy universe? Shall feeble man
Think it beneath his proud philosophy
To call for thy assistance, and pretend
To frame a world, who cannot frame a clod?——
Not to know thee, is not to know ourselves—
Is to know nothing—nothing worth the care
Of man's exalted spirit—All becomes,
Without thy ray divine, one dreary gloom;
Where lurk the monsters of fantastic brains,
Order bereft of thought, uncaus'd effects,

Fate freely acting, and unerring chance.
Where meanless matter to a chaos sinks,
Or something lower still; for without thee
It crumbles into atoms void of force,
Void of resistance—it eludes our thought.
Where laws eternal to the varying code
Of self-love dwindle. Interest, passion, whim,
Take place of right and wrong; the golden chain
Of beings melts away, and the mind's eye
Sees nothing but the present. All beyond
Is visionary guess—is dream—is death.

FINIS.

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ERRATA.

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Page 13, line 11, For *that* read *which*.
24, — 27, — *possess* — *have*.
—, — 28, — *do* — *have*.
65, — 1, dele *bigger*.
100, — 27, — *most*.
102, — 19, for *their* — *his*.
106, — 5, — *so* — *to*.
232, — 25, dele *though*, and
— 28, after *vouch* insert *yet it*.
327, — 13, for *fish* read *flesh*.

VOL. III.

46, — 4, after *and* insert *having*.
49, — 3, for *a log* read *logs*.
— 25, after *them* insert *was found*.
50, — 16. for *it* read *this*.
— 18, — *this* — *these*.
51, — 15, — *their* — *his*.

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